SERVICE MANUAL PM 6650

PHILIPS

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SERVICE

Cryogenic Equipment / Electro Analytical Equipment / Electronic Weighing / Electron Optics / Industrial Data Processing systems / Numerical Control / Radiation Measuring Equipment / Test and Measuring Equipment / Welding Equipment / X-Ray Analysis

equipment for science and industry

760331 PM 6650 SPC 13

TEST AND MEASURING INSTRUMENTS

New unit U5 for counter PM6650

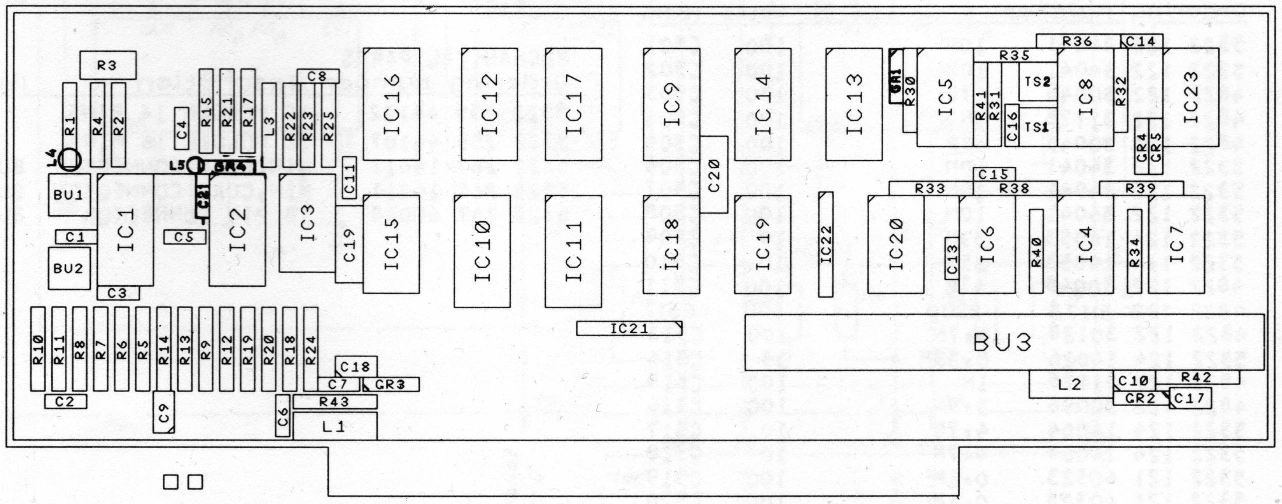
A new unit U5 has been designed for the counter PM6650. Newer models of PM6650 will be provided with this unit with codenumber 5322 216 64183. It is recommended also to replace the old unit U5 in all PM6650.

Insert this information after page 14-65 in your service manual.

D.C. level adjustment

The d.c. level is adjusted at the factory, however, to compensate slight differences between instruments it may be necessary to make a readjustment. Proceed as follows:

- Connect a HF generator set to 550 MHz continuous wave and 20mVrms (into 50Ω) to input C.
- Adjust R503 to stable display read out.



Component layout

ELECTRICAL PARTS

FIXED RESISTORS

Ordering number	Ω	%	Type	Item
4822 110 63078	82	5	CR25	R501
5322 116 54525	511	1	MR25	R502
4822 110 63089	220	5	CR25	R504
4822 110 63098	470	5	CR25	R505
4822 110 63101	560	5	CR25	R506
4822 110 63089	220	5	CR25	R507
4822 110 63094	330	5	CR25	R508
4822 110 63101	560	5	CR25	R509
4822 110 63081	100	5	CR25	R510
4822 110 63081	150	5	CR25	R511
2188 110 60098	470	5	CR25	R512
4822 110 63098	470	5	CR25	R513
4822 110 63096	390	5	CR25	R514
4822 110 63089	220	5	CR25	R515
5322 111 30298	120	5	CR16	R516
2188 110 60085	150	5	CR25	R517
4822 110 63134	10K	5	CR25	R518
4822 110 63134	10K	5	CR25	R519
4822 110 63134	10K	5	CR25	R520
4822 110 63134	10K	5	CR25	R521
4822 110 63109	1,2K	5	CR25	R522
4822 110 63114	1,8K	5	CR25	R523
4822 110 63114	1,8K	5	CR25	R524
4822 110 63107	1K	5	CR25	R525
5322 111 30298	120	5	CR16	R526
4822 110 63107	1K	5	CR25	R530
4822 110 63125	4,7K	5	CR25	R531
4822 110 63134	10K	5	CR25	R532
4822 110 63118	2,7K	5	CR25	R533
4822 110 63118	2,7K	5	CR25	R534
4822 110 63107	1K	5	CR25	R535
4822 110 63063	22	5	CR25	R536
4822 110 63081	100	5	CR25	R538
4822 110 63134	10K	5	CR25	R539
4822 110 63107	1K	5	CR25	R540
4822 110 63089	220	5	CR25	R541
4822 110 63107	1K	5	CR25	R542
4822 110 63107	1K	5	CR25	R543

VARIABLE RESISTOR

Ordering number	Ω	%	Item
5322 101 14051	220	20	R503

FIXED CAPACITORS

Ordering number	F	Volts	Item
5322 122 34041	10N	100	C501
5322 122 34041	10N	100	C502
4822 122 30045	47P	100	C503
4822 122 31175	1N	100	C504
4822 122 30045	47P	100	C505
5322 122 34041	10N	100	C506
5322 122 34041	10N	100	C507
5322 122 34041	10N	100	C508
5322 124 14053	33M	10	C509
5322 124 14053	33M	10	C510
4822 122 30045	47P	100	C511
4822 122 31173	220p	100	C512
4822 122 30128	4,7N	100	C513
5322 124 14026	0,33M	35	C514
4822 122 31175	1N	100	C515
4822 122 30098	3,9N	100	C516
5322 124 14064	4,7M	10	C517
5322 124 14064	4,7M	10	C518
5322 121 40323	0,1M	100	C519
5322 121 40323	0,1M	100	C520

DIODES

Ordering number	Type	Item
5322 130 30613	BAW 62	GR501
5322 130 30613	BAW 62	GR502
5322 130 30613	BAW 62	GR503
5322 130 34047	BZX75-C1V4	GR504

TRANSISTORS

Ordering number	Type	Item
4822 130 40959	BC547B	TS501
5322 130 44104	BC328	TS502

INTEGRATED CIRCUITS

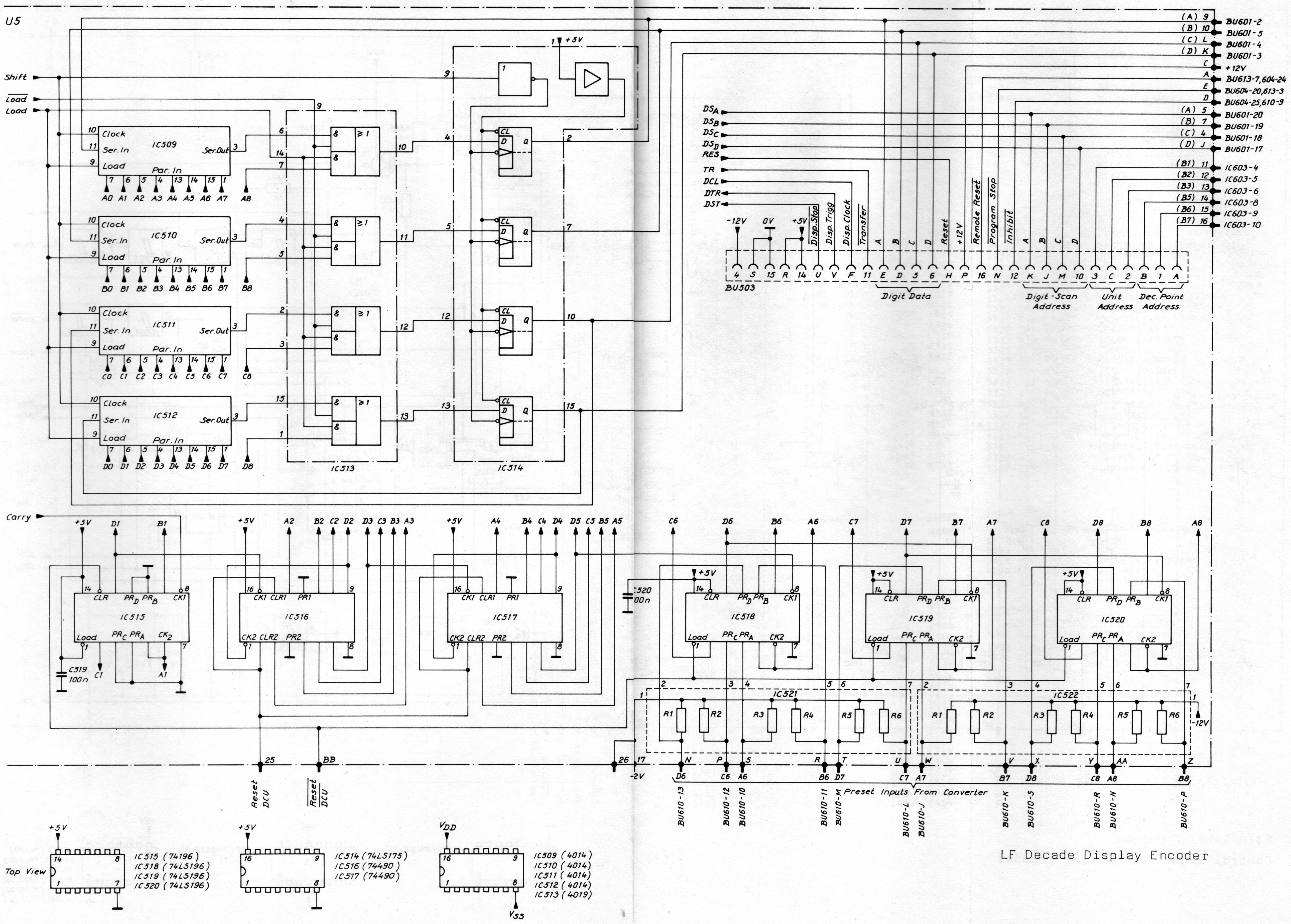
Ordering number	Type	Item
5322 209 85203	IC95209DC FAIRCHILD	IC501
5322 209 85204	ICSP8635B PLESSEY	IC502
5322 209 85195	ICSN74S20N TEXAS	IC503
5322 209 84996	ICSN74LS10N TEXAS	IC504
5322 209 85199	ICSN74LS14N TEXAS	IC505
5322 209 85198	IC74LS196N TEXAS	IC506
5322 209 85201	ICSN74LS132N TEXAS	IC507
5322 209 85199	ICSN74LS14N TEXAS	IC508
5322 209 85196	ICCD4014AE RCA	IC509
5322 209 85196	ICCD4014AE RCA	IC510
5322 209 85196	ICCD4014AE RCA	IC511
5322 209 85196	ICCD4014AE RCA	IC512
5322 209 85197	ICCD4019AE RCA	IC513
5322 209 84999	ICSN74LS175N TEXAS	IC514
5322 209 84168	ICSN74196N TEXAS	IC515
5322 209 85202	ICSN74490N TEXAS	IC516
5322 209 85202	ICSN74490N TEXAS	IC517
5322 209 85198	ICSN74LS196N TEXAS	IC518
5322 209 85198	ICSN74LS196N TEXAS	IC519
5322 209 85198	ICSN74LS196N TEXAS	IC520
5322 111 94012	6X6,8K KOA DENKO	IC521
5322 111 94012	6X6,8K KOA DENKO	IC522

INDUCTANCES

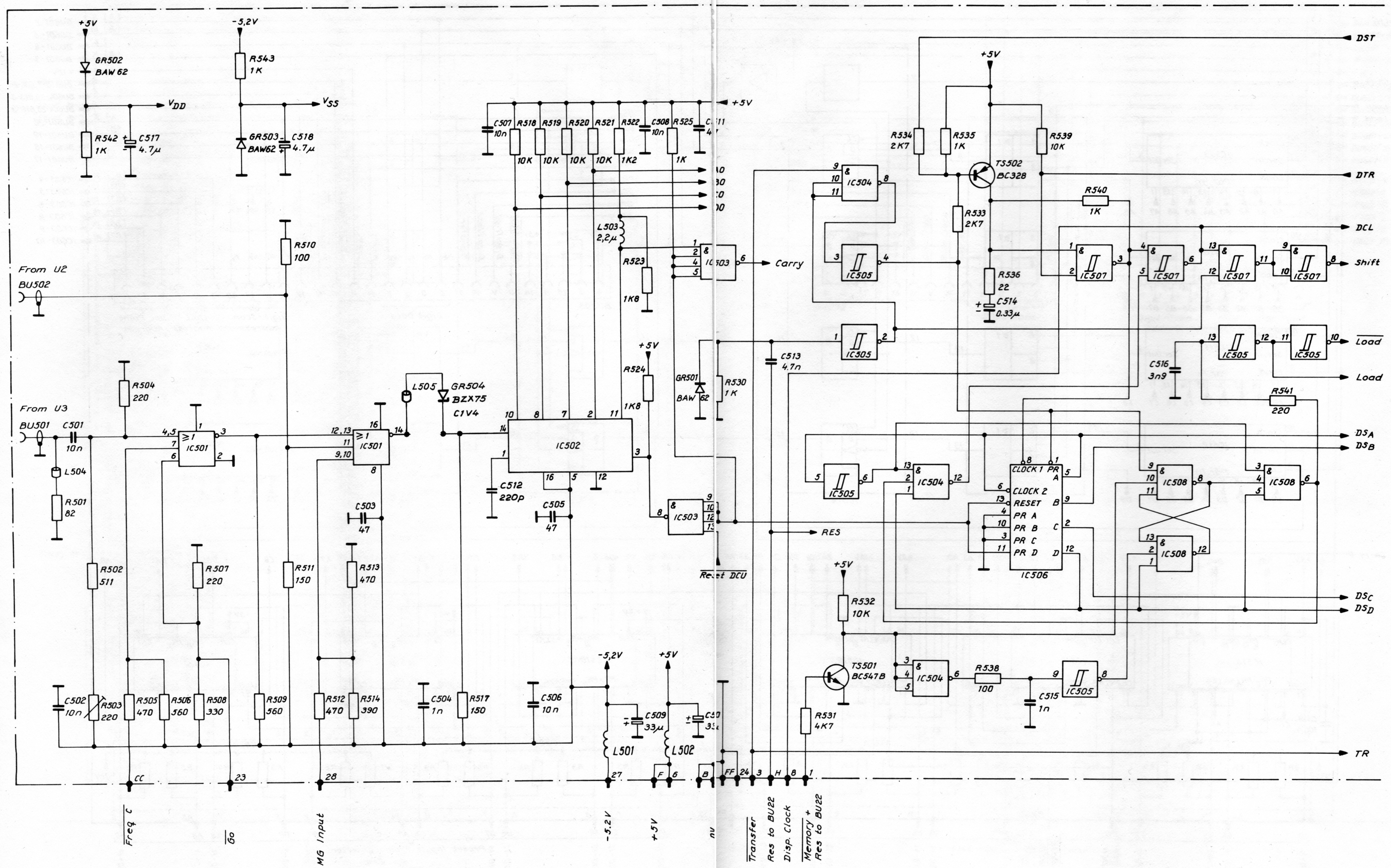
Ordering number	Description	Item
5322 158 10052	CHOKE	L501
5322 158 10052	CHOKE	L502
5322 158 10272	INDUCTANCE 2,2MH	L503
4822 526 10011	FXC BEAD	L504
4822 526 10011	FXC BEAD	L505

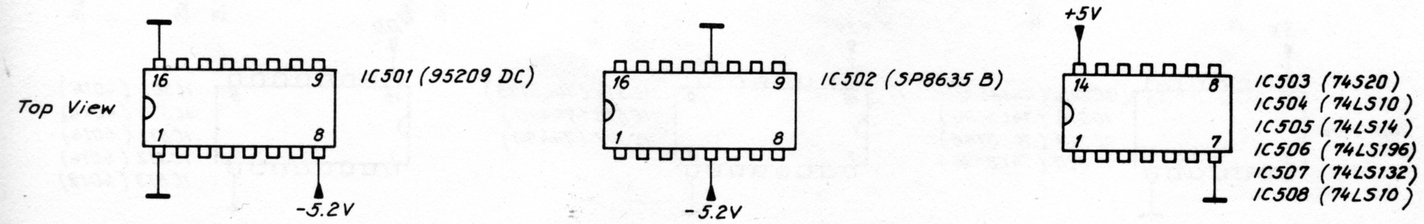
MECHANICAL PARTS

Ordering number	Description	Item
5322 255 44122	IC HOLDER 14 PINS	
5322 255 44107	IC HOLDER 16 PINS	
5322 267 14011	MIN.COAX CONNECTOR	BU501
5322 267 14011	MIN.COAX CONNECTOR	BU502
5322 267 60048	18 PIN CONNECTOR	BU503



LF Decade Display Encoder





Main Gate HF Decade
Control Logic for Display Encoder

PHILIPS

COUNTER/TIMER 512 MHz/1ns PM 6650

9446 066 50...1

Service Manual

CONTENTS

XIV. PARTS LIST, UNIT ASSEMBLIES, CIRCUIT DIAGRAMS

LIST OF FIGURES

IX. TECHNICAL DESCRIPTION

1. Introduction

The principles of function of the PM 6650 are explained with the aid of detailed block diagrams, in which the relevant signal paths are indicated with coloured lines. There is one block diagram for each measuring mode. The description of some circuits refer to the circuit diagrams which can be found in chapter XIV.

1.1. Key to abbreviations used in the diagrams:

a. General

HIGH = logical "1"
LOW = logical "0"
\+ = or
· = and

b. Measuring modes

Fq A = Frequency A
Fq C = Frequency C
P = Period
PA = Period Average
TI = Time Interval
TIA = Time Interval Average

c. Control signals

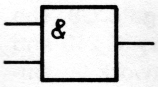
The control signals are generated by a control logic section on unit U4 controlled by the TIME BASE and FUNCTION switches.

A = Fq A + Count A + Ratio
B = TIA
C = Fq C + SUB-UNIT (Prescaler + Converter)
D = TI
E = P
F = Count A
J = Ratio
K = PA + Count A
L = PA + TIA + Check + Fq A + Fq C + Ratio
M = Fq A + Fq C + Check + P + TI
R = TI + TIA
S = $\overline{10\ \text{ns}}$ · (P + TI)
T = 10 ns · (P + TI) + Check + PA + TIA
U = 10 ns

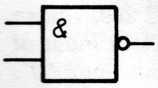
Explanation: Control signal "A" is "1" in measuring modes Frequency A *or* Count A *or* Ratio.
Control signal "S" is "1" in Period *or* Time Interval if the time base is *not* 10 ns.

1.2. Schematic symbols

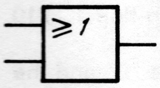
a. Logical symbols:



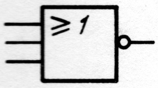
AND gate



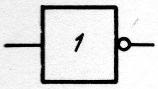
NAND gate



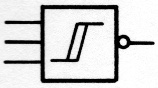
OR gate



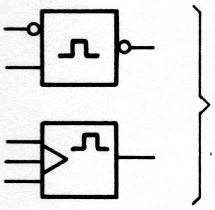
NOR gate



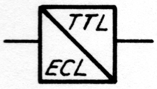
Inverter



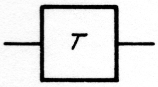
NAND/Schmitt trigger combination



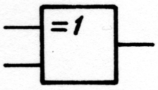
Monostable multivibrator



ECL to TTL interface

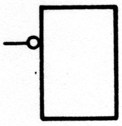


Schmitt trigger

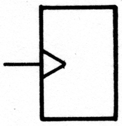


Exclusive-OR gate

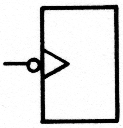
b. Input designation of flip-flops:



Inverting input



Clock input, triggers on positive slope



Clock input, triggers on negative slope

2. CHECK

Block diagram fig. IX-1

The 10 MHz clock signal generated by the internal oscillator on unit U6 is amplified and fed via NAND gate network G13, G15 and G16 to the × 10 multiplier on unit U3.

Control signal T is "1" and enables AND gate G8. The 100 MHz signal is routed to the D flip-flops IC 210 and NOR gate G10 on unit U2. This gating network is controlled by signals $\overline{B}$ and T. The $\overline{B}$ signal is "1" and presets the both D flip-flops IC 208 and IC 209, whose Q outputs will be "1", and is fed to the Clear input of one of the flip-flops IC 210 whose Q output goes "0". The T control signal is made "0" by inverter 4 and is fed to the Clear input of the second flip-flop IC 210 whose $\overline{Q}$ output goes "0".

Two of the inputs of NOR gate G10 is thus "0" and the 100 MHz time base signal is gated to the main gate configuration IC 501 on unit U5.

Control signal $\overline{C}$ enables AND gate G17 which gates the signal further to OR gate G19 and Schmitt trigger T to NAND gate G20. This gate has two inverting inputs which both must be "0" to enable the gate. One of these inputs is controlled by control signal C which is fed through inverter 3 and NOR gate G7 on unit 3. Its complement $\overline{C}$ is a logical "1" enabling AND gate G17 in IC 501.

The second inverting input of G20 is controlled by the time base signal derived from the internal clock oscillator on unit U6. From NAND gate G16 it is applied to AND-NOR gate configuration G24 and further via the Time Base Divider, gating network G30, G31, G25, to the clock input of the Gate flip-flop IC 415.

When the $\overline{Q}$ output goes low, the main gate G20 is opened and the 100 MHz signal can pass through to binary divider IC 502, quinary divider IC 503 and further to the decade counters IC 511 . . . IC 518.

Refer to the description in section 11. "Transfer and Reset Signals" for the decade counters, shift-register and display driver functions.

1R
1G

Fig. IX-1. CHECK

3. FREQUENCY A AND BURST

Block diagram fig. IX-2

3.1. FREQUENCY A

The signal to be measured is applied to input channel A and is fed via the DC/AC coupling to the amplifier section TS 701, GR 701, GR 702 and TS 702, TS 705. A further amplification and shaping is made on unit U2 in TS 201, 208, and Schmitt trigger TS 209—210.
IC 203—205 provide slope selection.
The signal is taken out to monostable multivibrator IC 209 and is fed via an ECL/TTL interface stage IC 207 to a second monostable multivibrator controlling the channel A triggering indicator, light-emitting diode GR2. When the input signal to be measured is a continuous wave, and has a frequency higher than 10 Hz, the output of IC 211 is low, and the diode lights permanently.
Via NOR gate G9, which is enabled by control signal A, the signal goes further to unit U5 to the main gate configuration IC 501, in which it is applied to the main gate G20.
The two inverting inputs of this NAND gate must be "0" to allow the signal to pass through to the decade counters.
One of the inputs is permanently low because it is controlled by control signal C via inverter 3 and NOR gate G7 on unit U3.

The second inverting input of G20 is controlled by the time base signal derived from the internal clock oscillator on unit U6. The clock signal is gated through NAND gate G13. The second input of G13 is "1" at normal frequency measurement.
Via NAND gate network G15 and G16, AND-NOR configuration G24 the clock signal is routed to the Time Base Divider. The divided signal is then gated via G30, G31 and G25 to the clock input of the Gate flip-flop, whose $\overline{Q}$ output is connected to the Main Gate G20 on unit U5.
When the $\overline{Q}$ signal goes low, the Main Gate is enabled and the measuring signal can pass on to the fastest decade IC 502, 503 and further to the decade counters IC 511 . . . IC 518.

3.2. BURST measurement

When measuring e.g. a pulsed carrier wave, the BURST mode is used. When no signal is present, i.e. between the bursts, the output of monostable multivibrator IC 209 on unit U2 is "0". This level is fed via ECL/TTL interface circuit IC 207 to NAND gate G4 on unit U3, whose output goes HIGH.
The latch flip-flop formed by G5 and G2 is then set to "1" by the Reset pulse. This "1" is inverted by NAND gate G3 to a "0" disabling NAND gate G13 on unit U6.
The clock signal is then inhibited.
When a burst occurs, monostable multivibrator IC 209 generates a pulse to NAND gate G4. Its output goes LOW and the latch flip-flop G5, G2 is set to "0".
The logical "1" provided by G3 enables gate G13 and the clock signal can pass on to the time base divider and via the Gate flip-flop to the main gate G20.
When the burst ceases, monostable multivibrator IC 209 goes LOW again, and the input of latch G5, G2 is set to "1". The reset pulse generated by the counter after the measurement is applied to the second input at gate G2 and the latch is reset to "1". Gate 13 is then disabled and the clock signal is inhibited until the next burst occurs.

Fig. IX-2. FREQUENCY A, BURST

4. FREQUENCY C AND BURST

Block diagram fig. IX-3

4.1. FREQUENCY C

The signal to be measured is applied to input C and attenuated by two PIN diodes GR 301, 302. These diodes, which act as variable resistances, are biased by detector diodes GR 303, GR 304 and decrease their resistance when the bias is increasing.

The next PIN diode attenuator is biased by the automatic gain control (AGC) detector GR 310, 311 via operational amplifier IC 301. The detected signal is also tapped off to the level detector, operational amplifier IC 305, which is controlling the input indicator, light-emitting diode GR1, and NOR gate G7.

When the level of the signal to be measured is sufficient for error-free counting, the level detector provides a LOW level to diode GR1 which turns on, and to G7 which is enabled by control signal C. The signal from the level detector then can pass through the gate as a logical "0" and further to the main gate G20 on unit U5.

The signal to be measured is further amplified by TS 307 and routed via limiters GR 312, 313 to the main gate configuration IC 501 on unit U5.

Via AND gate G18, which is enabled by control signal C, and OR gate G19, the signal is fed to a Schmitt trigger and further to the main gate G20.

As mentioned previously, one of the inverting inputs of this gate is controlled by the level of the signal arriving as a logical "0" from NOR gate G7 on unit U3. The second inverting input is controlled by the time base signal originating from the 10 MHz internal clock oscillator on unit U6. The clock signal is gated via NAND gates G13, G15 and G16 on unit U6, to the Time Base Divider via G24 on unit 4. After division, as set by the front panel Time Base switch, the signal is routed to the Gate flip-flop IC 415 via gate network G30, G31 and G25.

The Gate flip-flop controls the main gate G20.

When the Q output is LOW, the main gate is enabled and the signal to be measured can go further to the decade counters.

The function of the decade counters and the shift registers are described in section 11. "Transfer & Reset Signals".

4.2. BURST measurement

When measuring e.g. a pulsed carrier wave, the BURST mode is used. When no signal is present, i.e. between the signal bursts, the output of Level Detector IC 305 is "0" and the output of NAND gate G1 is "1". A reset pulse has set the latch flip-flop G2, G5 to "1".

Because the BURST mode is selected, all three inputs of NAND G3 are "1". A LOW level is now routed to gate G13 on unit U6 and the clock signal is inhibited.

When the signal burst occurs, the Level Detector IC 305 provides a LOW signal to inverter 1, IC 302.

The output of NAND G1 goes LOW which sets the latch G2, G5 to "0". Gate G3 goes HIGH which enables gate G13 on unit U6.

The clock signal can now pass on to the main gate.

When the signal burst ceases, the Level Detector output goes HIGH which sets the input of latch G2, G5 to "1". The output state of the latch, however, is maintained until the Reset pulse is generated after the set gate time. Then the second input of NAND G2 in the latch configuration goes LOW, the input of G3 goes HIGH and the clock gate G13 on unit U6 is disabled.

No clock pulses are provided to the main gate until the signal burst occurs again.

Fig. IX-3. FREQUENCY C, BURST

5. RATIO A/B

Block diagram fig. IX-4

In this mode the counter measures the relation between a higher frequency f_A applied to input A and a lower frequency f_B applied to input B.

Frequency f_B is used as the control signal which via the time base dividers is controlling the main gate. Frequency f_A is counted during the "gate open" interval and the counter presents the relation between the both signals.

Input signal f_A passes the DC/AC coupling network and amplifier and limiter networks TS 701, GR 701, 702 and TS 702, 705 on unit U7. After further amplification and pulse shaping in TS 201—208, Schmitt trigger TS 209—210, the signal is fed to slope selection circuit IC 203—205, and further to NOR gate IC 212. The second input of this gate is permanently LOW in the RATIO mode, and the signal to be measured can be routed to the main gate configuration IC 501 on unit U5. AND gate G17 is enabled because control signal C is permanently "1" in the RATIO mode. The signal is gated to OR gate G19 and further via a Schmitt trigger to main gate G20. This NAND gate has two inverting inputs which both must be LOW to enable the gate.

One of the inverting inputs is kept permanently at LOW level by control signal C which is applied to the main gate via inverter 3 and NOR gate G7 on unit 3.

The second inverting input of G20 is controlled by the time base signal derived from signal f_B applied to input B. f_B is amplified and shaped just as signal f_A. After the slope selection network, the signal passes through an ECL/TTL interface circuit IC 207 and further to the input of the AND-NOR gate configuration G24. The second input of the AND gate is kept HIGH by control signal J which is permanently "1" in the RATIO mode. The output of G24 controls the Time Base Divider in which the signal frequency is divided as set by the front panel control TIME BASE. The divided signal is fed via gating network G30, G31 and G25 to the Gate flip-flop IC 415, whose complementary output Q controls the main gate G20. When $\bar{Q}$ goes LOW, the main gate is enabled and counting takes place.

The principal function of the decade counters and the display stage is described in section 11. "Transfer and Reset Signals".

4R
4B
4G

Fig. IX-4. RATIO A/B

6. TOTALIZE mode, COUNT A gated by B

Block diagram fig. IX-5

6.1. TOTALIZE mode (scaling)

When front panel switch FUNCTION is set to COUNT A, the number of pulses applied to input A are counted during an interval which is manually determined with switch START/STOP, SK5, or automatically by a gating signal applied to input B. The signal to be counted is applied to input A and is fed via the AC/DC coupling and attenuation networks to the amplifier and limiter circuits on unit U7.

Next, the signal is further amplified and shaped on unit U2 and is fed via NOR gate G9 to the main gate configuration IC 501 on unit U5. At the input of NOR gate G9, however, the signal is tapped off and is routed via ECL to TTL interface circuit IC 207 to AND/NOR gate configuration G24 on unit U4. The second input of the AND gate is kept permanently at logical "1" by control signal K, which allows the signal to go on to the Time Base Divider. Here the signal is divided by a factor set with the TIME BASE/MULTIPLIER switch. The divided signal is gated via G30, G31 back to unit U2. NOR gate G12 is enabled by control signal T which is permanently "0" in the COUNT A mode. The scaled signal can pass through via an amplifier to the rear panel TIME BASE OUT socket.

The signal which has reached the main gate configuration IC 501 on unit U5 is gated via G17, G19 and a Schmitt trigger to main gate G20. This gate has two inverting inputs which must be "0" to enable the gate. One of the inputs is kept permanently at logical "0" by control signal C supplied from unit U3 via inverter 3 and NOR gate G7.

6.2. MANUAL OPERATION (START/STOP)

The second inverting input of main gate G20 is controlled by the START/STOP signals. When the START switch SK5 is depressed, the data selector on unit U6 provides a LOW signal to NAND gate G28 on unit U4. The second input of G28 is HIGH because no "Gated by B" signal is present. The output of G28 will go HIGH and trigger the START flip-flop IC 426 whose output $\overline{Q}$ provides a preset signal to the Gate flip-flop IC 415.

This flip-flop generates a LOW signal to the main gate G20, which becomes enabled. The signal to be counted is then gated to the decade counters and the display unit described in section 11. "Transfer and Reset Signals".

6.3. "GATED BY B" OPERATION

The gating signal is applied to input B and fed just as the A signal through the B input conditioning circuits. After the slope selector on unit U2, the signal is picked off to monostable multivibrator IC 208 and IC 211 which controls the input indicator LED GR3. The main signal path goes further via ECL-to-TTL interface circuit IC 207 to NAND gate G27 on unit U4. This gate is enabled by a logical "1" at the second input. The next NAND gate G28 is also enabled in the GATED BY B mode which makes that the B signal can be applied to the clock input of the START flip-flop IC 426. A 0 to 1 transition of the B signal makes the $\overline{Q}$ output go LOW which is presetting the GATE flip-flop's $\overline{Q}$ output to LOW. This will enable the main gate G20 on unit U5 so that the signal to be counted can pass on to the decade counters and display unit described in section 11. "Transfer and Reset Signals".

5R
5B
5G

Fig. IX-5. TOTALIZE, COUNT A GATED BY B

7. PERIOD A

Block diagram fig. IX-6

In the single period measurement mode, the main gate is controlled by the input signal applied to input A. The internal clock signal is counted during an interval determined by the period of the input signal.

The input signal is conditioned and amplified on unit U7 and unit U2. After the slope selector network IC 203—IC 205, the signal is picked off to monostable multivibrators IC 209, 211 which control trigger indicator LED GR2.

The main path of the signal is, however, through ECL-to-TTL interface IC 207 and further to unit U4 where the signal is gated through G25 to the clock input of the gate flip-flop IC 415. The Q output of this flip-flop provides the control signal for the main gate G20 on unit U5. The second control input of G20 is kept permanently at logical 0 by control signal C which is gated from the control logic section on unit U4 via U3 to the main gate configuratin on unit U5.

Thus, when the gate flip-flop signal $\overline{Q}$ goes LOW, the main gate is enabled and counting takes place.

The internal 10 MHz clock signal, which is counted in the period measurement mode, is taken from the oscillator section on unit U6 and gated to the time base divider on unit U4 via NAND gates G13, G15, G16, and AND-NOR gate G24.

The time base divider scales the signal as set with the TIME BASE switch, and the scaled signal is gated via G30, G31 on unit U4, G11 on unit U2 to the main gate configuration IC 501 on unit U5.

On unit U2, the second input of NOR gate G12 is kept permanently at logical "0" by control signal T, which makes the scaled signal available at rear output Time Base Out.

At a TIME BASE setting of 10 ns, the clock signal has a different signal path as described in section 8, "Period Average".

When gated through the main gate G20, the scaled clock signal is fed to the decade counters, which are described in section 11. "Transfer and Reset Signals".

Fig. IX-6. PERIOD A · $\overline{10 \text{ ns}}$

8. PERIOD AVERAGE A

Block diagram fig. IX-7

The input signal applied to input A is conditioned and amplified on units U7 and U2 before it is gated to the Time Base Divider on unit U4. The division factor is set with the MULTIPLIER switch SK 603 which controls the Time Base Divider via the Data Selector on unit U6 and the Control Logic section on unit U4.

The shaped and scaled input signal is then gated via G30, G31 and G25 to the Gate flip-flop which provides the "enable" signal for the main gate G20 on unit U5. The second inverting input of the main gate is kept permanently at logical 0 by control signal C, originating from the Control Logic section on unit U4 and gated via G7 on unit U3 to the main gate.

When the main gate is enabled by the control signal from the Gate flip-flop, the time base signal is gated to the decade counters.

The signal path for the time base signal is as follows. The 10 MHz clock signal generated by the oscillator on unit U6 is gated via NAND gates G15 and G16 to the Multiplier on unit U3.

The Multiplier provides a 100 MHz signal which is routed via AND gate G8, being enabled by control signal T, to the flip-flop arrangement on unit U2. These flip-flops, IC 210 and IC 209, provide the LOW levels necessary to enable NOR gate G10 which supplies the 100 MHz signal to the main gate configuration IC 501 on unit U5. Control signal $\overline{B}$, originating from the Control Logic section on unit U4, is applied as a logical "1" to the Preset inputs of flip-flop IC 209. This means that the Q output is permanently "1" which is applied to the D input of flip-flop IC 210. Because the Clear input is set to "0" by control signal T via inverter 4, the D state is clocked over to the Q output, which makes that output $\overline{Q}$ is "0". The second flip-flop IC 210 is cleared by control signal $\overline{B}$, which means that the Q output is "0".

NOR gate G10 is thus enabled and the 100 MHz time base signal is routed to the main gate configuration IC 501, where it is gated to the input of the main gate G20. When the divided and shaped input signal from the Gate flip-flop goes LOW the 100 MHz time base signal is fed through the main gate and counted by the decimal counting unit described in section 11. "Transfer and Reset Signals".

7R
38
76

Fig. IX-7. PERIOD AVERAGING A

9. TIME INTERVAL A TO B

Block diagram fig. IX-8

The signal applied to channel A starts a measurement and the signal applied to channel B stops the measurement. In the start to stop interval, the time base frequency derived from the internal clock oscillator is counted. The time base frequency is multiplied to 100 MHz in the 10 ns position of the TIME BASE switch. In the remaining TIME BASE settings the 10 MHz clock signal is divided in the Time Base Divider.

The Start signal at input A is conditioned and amplified in units U7 and U2 and fed via ECL-to-TTL interface IC 207 to AND-OR gate G25 on unit U4. The two other inputs of the AND gate are "1", one by control signal D and the second by the $\overline{Q}$ output of Gate flip-flop IC 415. G25 is thus enabled and provides a positive edge to the clock input of the Gate flip-flop. Then the logical "1" at the D input is transferred to the Q output which means that the $\overline{Q}$ output goes to "0". The START AND gate of G25 will be inhibited, but the main gate G20 on unit U5 is enabled.

The time base signal is now counted until the stop pulse arrives from channel B to G25.

G25 provides a clock pulse to the Gate flip-flop whose output Q goes to "0" which inhibits the stop gate of G25. Output $\overline{Q}$ goes to "1" which is closing the main gate G20 and, at the same time, enabling the start gate of G25 which is then armed for the next start pulse from channel A.

The signal path for the time base (TB) signal is indicated in the block diagram for a Time Base setting of 10 ns, i.e. Single time interval measurement. The internal 10 MHz oscillator signal is gated via G13, G15 and G16 on unit U6 to the Multiplier on unit U3. Next, the 100 MHz signal is gated through G8 to G12 on unit U2. This gate is enabled by control signal U, generated by the Control Logic section on unit U4 and gated via G31 to G12. The output of G12 is amplified and available at rear output connector TIME BASE OUT. The main path for the 100 MHz signal goes, however, to the clock input of D flip-flop IC 210 and one of the inputs of NOR gate G10.

Flip-flop IC 209 which is preset by control signal $\overline{B}$, provides a logical "1" to the Data input of IC 210. When triggered by the time base signal, this logical "1" is transferred to the Q output which makes the Q output go to "0".

This state is permanent as long as the clock signal is present. The second flip-flop IC 210 provides a logical "0" from its $\overline{Q}$ output to G10 because its Clear input is set to "1" by control signal $\overline{B}$. These two signals from the IC 210 flip-flops will enable NOR gate G10 so that the 100 MHz signal can pass through further to the main gate configuration IC 501 on unit U5. Via gates G17, G19 and a Schmitt trigger T the signal reaches the main gate G20. One of the inverting inputs of G20 is kept permanently "0" by control signal C generated by the Control Logic section on unit U4 and gated via inverter 3 and NOR gate G7 on unit U3 to the main gate.

The second inverting input of the main gate is controlled by the gate flip-flop as described previously.

If another time base setting than 10 ns is used, the signal path for the internal time base signal will be different (indicated Time Base $\overline{10\text{ ns}}$ in the block diagram).

The 10 MHz signal generated by the internal clock oscillator on unit U6 is gated via G15 and G16 to one of the inputs of AND-NOR combination G24 and further to the Time Base Divider. Depending on the setting of the TIME BASE/MULTIPLIER switch, the signal is divided by factors 10^0, 10^1, 10^2, 10^3, 10^4, 10^5 etc., and fed via G30 to NOR gate G31. The second input of this gate, which is "1" at the 10 ns setting, is now "0" enabling the divided time base signal to pass on further to G12 and G11 on unit U2. The second input of G12, which is used as the 100 MHz input at 10 ns time base, is now "0" because control signal T applied via gate G8 on unit U3 is "0". The divided time base signal will then be available at rear output TIME BASE OUT. At gate G11, the $\overline{S}$ input is "0" which permits the time base signal to pass on to the main gate configuration IC 501 on unit U5 and further to the main gate G20 via G19 and Schmitt trigger T.

8B
8R
8G

Fig IX-8 TIME INTERVAL A TO B · 10 ns

10. TIME INTERVAL AVERAGING A TO B

Block diagram fig. IX-9
Timing diagram fig. IX-10

In this mode a prescaled number of time intervals are counted and presented with their statistical mean value. Just as in the Single Time Interval measurement, the Start signal is applied to input A and the Stop signal to input B.

The time base signal is always 100 MHz independent of the TIME BASE control setting.

The main gate G20 is controlled by the Stop signal in the following way. After conditioning and amplification, in the B input stage of units U7 and U2, the Stop signal is applied to one-shot IC 208 and the clock input of D flip-flop IC 208. The logical "1" at the D input is thus transferred to the Q output. The one-shot generates the driving signal for input indicator GR3 via interface IC 207 and a second one-shot IC 211.

The Q output of D flip-flop IC 208 is connected to the Data input of the next D flip-flop IC 210. When the first positive edge of the 100 MHz time base signal arrives, the D state is transferred to the Q output which is connected to one of the inputs of NOR gate G10 and the one-shot IC 204. This one-shot stretches the stop pulse which is routed via ECL-to-TTL interface circuit TS 226 to AND-NOR combination IC 411 (G24) on unit U4. This gate is enabled by control signal B and the stop pulses are accumulated in the Time Base Divider. The Divider is initially preset in such a way, that 14 input pulses are required before an output pulse is generated.

This pulse is gated via G30, G31 and G25 to the Gate flip-flop, whose Q output goes to "0". Then the main gate G20 on unit U5 is opened.

Thus, when a time interval averaging measurement starts, about 14 time intervals in the form of stop pulses must first enter the Time Base Divider in order to open the main gate. Then the real measurement starts as described in the following. The Start signal applied to input A is conditioned and amplified in the input stage on units U7 and U2, and then fed to the clock input of D flip-flop IC 209. The Data input of this flip-flop is permanently "1" which means that its Q output goes to "1" when the positive edge of the Start pulse arrives.

The Q signal is fed to the Data input of the next D flip-flop IC 210, whose clock input is connected to the 100 MHz time base signal. Thus, within 10 ns after the arrival of the Start pulse, the Q output of IC 210 goes to "0" which means that NOR gate G10 is enabled. The second control input of this gate is namely also "0" because the Q output of the second "Stop" D flip-flop is set to "0" by the Data input which is "0".

A number of 100 MHz pulses is then fed through G10 to the main gate G20 on unit U5 which is open as described above.

When a Stop pulse arrives from the B channel, the Q output of flip-flop IC 208 goes to "1". After at least 10 ns, when the clock pulse arrives to "Stop" flip-flop IC 210, its Data state "1" is transferred to the Q output which is inhibiting gate G10. The logical "1" of the Q output is also triggering the one-shot IC 204 which provides a stretched stop pulse which is fed via interface TS 226 and gate G24 to the Time Base Divider on unit U4 where it is stored. Simultaneously, the output of one-shot IC 204 sets the Clear inputs of flip-flops IC 208 and IC 209 to "1", which makes that their Q outputs go to "0".

Since these Q outputs are connected to the Data inputs of the Start and Stop flip-flop IC 210, respectively, the next clock pulse will cause the Q output of the Start flip-flop to go to "1", and the Q output of the Stop flip-flop to go to "0".

The Start flip-flop is now "armed" and will switch over when the next Start pulse arrives to the clock input of IC 209. The cycle is then repeated and another Stop pulse is accumulated in the Time Base divider.

If the MULTIPLIER switch is set to, for example, 10^5, there must be 100 000 time intervals measured until the Time Base Divider generates a pulse to the Gate flip-flop. Its Q output then goes to "1" causing the main gate G20 to close.

The Time Base divider is then reset, which means that when another 14 time intervals are accumulated, a pulse is delivered to the Gate flip-flop which opens the main gate. Then the next measurement starts.

A more detailed description af the Time Base Synchronizer is given in section 13.

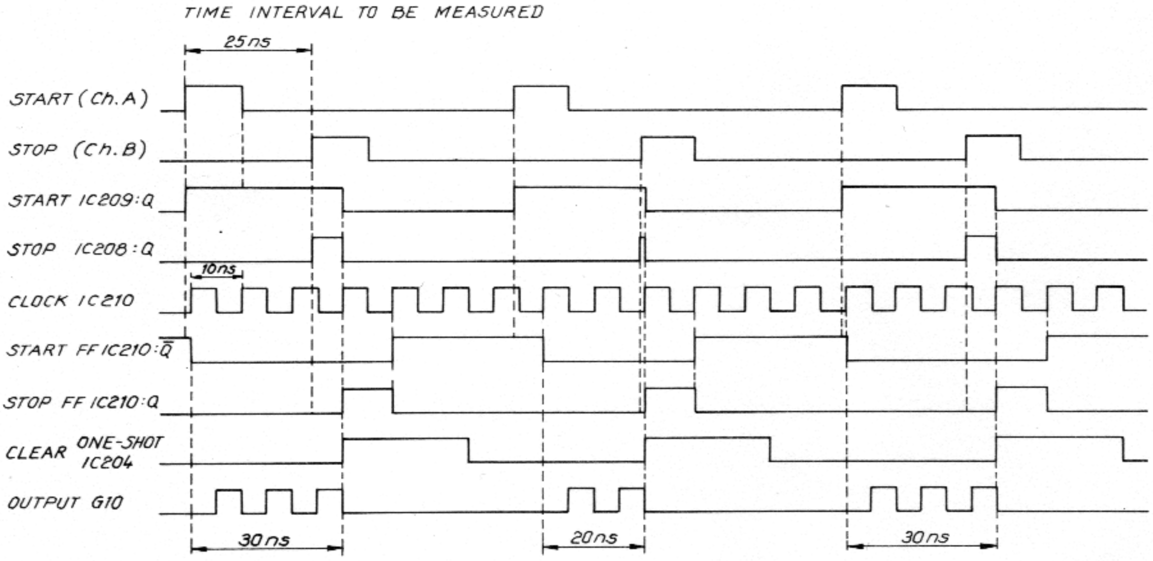


Fig. IX-10. Timing diagram Time Interval Averaging A to B

Fig. IX-9. TIME INTERVAL AVG A TO B

11. TRANSFER AND RESET SIGNALS

Block diagram fig. IX-11
Timing diagram fig. IX-12

11.1. Transfer pulse

Refer to timing diagram fig. IX-12.
When the main gate is closing, the Q output of the Gate flip-flop goes to "0". This negative transition will trigger the monostable Transfer multivibrator which generates a negative pulse to the Display Clock and the Address Counter on unit U5. The Display Clock is then inhibited. The Address Counter can provide addresses 0 through 9. The most significant decade (no 9) has address 9, decade no 8 has address 0 and so on to the least significant decade which has address 7. The transfer pulse presets the Address Counter to address 8, which is actually outside the display. This means that the D output is "1", and the other outputs A, B, C, are "0". The transfer pulse is also applied to the "set" input of latch flip-flop G21—G23 whose output goes to "1". NAND gate G22, which provides the "Load" signal for the shift registers, is then enabled.
After 2 μs (PM 6650 versions 01 and 02), or 10 μs, (version 03), the transfer pulse ceases, and the Display Clock starts. The Address Counter will go one step further to Address "9", which means that the A-B-C-D output will be 1-0-0-1. All three inputs of NAND gate G22 are now "1" because the latch flip-flop G21—G23 maintains its output state until a reset pulse occurs (D goes to "0"). Gate G22 generates a "Load" signal to the shift registers IC 519 through IC 522, which allows the information of the decade counters IC 511 through IC 518 and HF decade counter IC 502, IC 503, IC 506—IC 508, to enter the shift registers. The registers are loaded in such a way, that the information of the 9th most significant decade, A8 through D8, is stored at the output of the shift register. Simultaneously, the Address Counter provides address "9" to the BCD to Decimal Decoder and Driver on unit U1, which means that the most significant digit of the display shows the value determined by the information supplied from the decade counter via the shift registers.
At the next clock pulse generated by the Display Clock IC 509, the Address Counter provides binary address "0" i.e. for decade no. 8. Output D is thus "0" which resets the latch flip-flop G21—G23 to "0". The "Load" pulse will then disappear.

The Display Clock generates a "Shift" command pulse to the shift registers, which now provide the information of the 8th decade, A7 through D7, at their output. For each clock pulse there is a "shift" pulse, which means that the decade information is recycled in the shift registers as long as there is no "Transfer" pulse. The display is thus scanned with a frequency equal to 1/10 of the display clock signal frequency which is about 4 kHz. A transfer pulse is resetting the Address Counter to "8" and is followed by a "Load" pulse which loads the shift registers with new information from the decade counters.
If the MEMORY switch is released (memory off), a "Load" pulse is generated after each address "9" because the input of NOR gate G38 on unit U4 goes to "1". A logical "1" is generated to the inverting input of latch G21—G23 on unit U5 which sets the input to G22 to "1" and a "Load" pulse is generated as long as addresses A and D are "1". Now the display follows the decade counters continuously.

11.2. Reset pulse

When the Q output of the Gate flip-flop IC 415 goes HIGH, the main gate G20 is closed and the display time interval starts. Simultaneously, the Display flip-flop IC 415 is clocked by the positive transition of the GATE flip-flop. The Display flip-flop's Q output goes to "1" and NAND gate G36 provides a "0" to latch configuration G37—G39 whose output is set to "1". This starts a ramp generator TS 401, 402 which generates a negative-going ramp, whose slope is set with front panel DISPLAY TIME potentiometer R1. When the ramp voltage has reached the threshold level of Schmitt trigger IC 416, a reset pulse is generated, which is resetting the Time Base Divider, the high-frequency decade IC 502, IC 503 and the four decade counters IC 512 . . . IC 515. An inverted reset pulse is generated by inverter 12, which resets the remaining decade counters, and goes also via G33 to the Clear input of the Display flip-flop, whose Q output goes to "0". The "Set" input of latch configuration G37—G39 goes to "1". Simultaneously, the "Preset" input of the latch goes to "0" by the reset pulse, which makes the output of the latch go to "0". The ramp generator is then reset. When the threshold level of Schmitt IC 416 is passed, the reset pulse ceases. The duration of the reset pulse is about 1 ms.

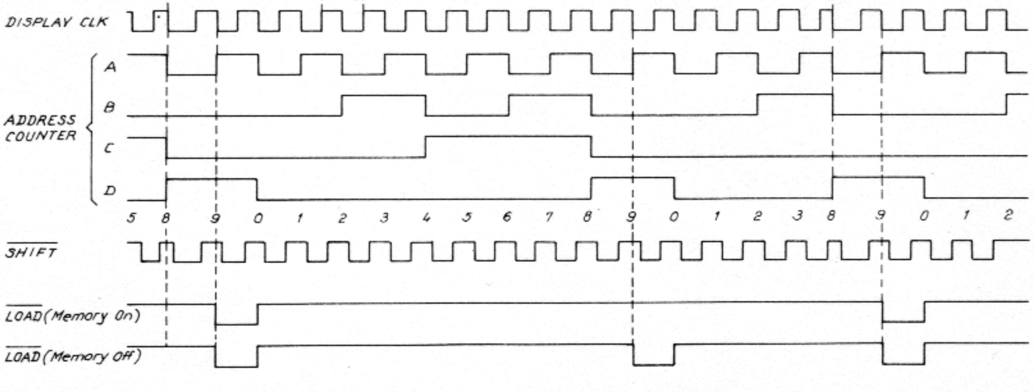


Fig. IX-12. Timing diagram Transfer, Address, Shift and Load signals

Fig. IX-11. TRANSFER AND RESET SIGNALS

12. POWER SUPPLY

12.1. Raw d.c. supply *(part of unit U6, refer to circuit diagram fig. XIV-13)*

The 220 V or 115 V mains voltage is rectified by bridge GR21. The smoothed + 17 V and — 17 V d.c. voltages are fed to units U9 and U8, which provide stabilised voltages of + 12 V, — 12 V, + 5 V and — 5.2 V.

The POWER ON switch SK7 operates the + 12 V line from unit U9 except that branch supplying the oven oscillator and the oscillator indicator.

+ 210 V for the display unit is generated by a dc/dc converter, consisting of a 40 kHz oscillator TS 601, 602 which is supplied with a + 12 V stabilised d.c. voltage, and a diode bridge GR 606 . . . GR 609 on the secondary side of transformer T 601.

12.2. + 5 V, — 5.2 V supply *(unit U8, refer to circuit diagram fig. XIV-18)*

12.2.1. General

This unit is fed via + 17 V and — 17 V raw d.c. voltages from the power supply section on unit U6 and the + 12 V stabilised d.c. voltage from unit U9 (see circuit diagram U6 fig. XIV-20).

The main parts of the circuit are the astable multivibrator IC 801, voltage regulators IC 802, IC 803, chopper series transistors TS 801, TS 802 and TS 806, TS 807, and circuits protecting against excess voltage and overload.

The terminal designations of voltage regular IC 802 are illustrated in fig. IX-13.

The stabilised + 12 V voltage is applied to input terminal IC 802:12. A 24 kHz square-wave generated by astable multivibrator IC 801 is applied to the non-inverting input IC 802:5 via integrating network C 803—R 803—C 805. The input signal is a triangular-wave with an amplitude of about 500 mV_{p-p} which is superimposed on a + 5 V d.c. voltage obtained from the reference voltage output IC 802:6 via voltage divider R 805, R 801, R 806.

R 801 presets the + 5 V level.

The purpose of the astable multivibrator IC 801 is to maintain a ripple frequency above the audible range independent of load variations. This is achieved as follows.

The output IC 802:11 is a 24 kHz square-wave which is controlling the series chopper transistor TS 801, TS 802. When TS 802 goes on, + 17 V is applied to an integrating filter network consisting of toroid choke L 801 and capacitor C 808.

When TS 802 turns off, the current path is through diode GR 803 and the output at junction R 817—C 808 is a + 5 V d.c. voltage with a superimposed 24 kHz triangular ripple of about 50 mV_{p-p}. The slope of the triangular wave is dependent of the load variations that may occur in other parts of the counter. The output voltage is fed back via R 817 to the inverting input 4 of regulator IC 802. The duration of the output pulses at IC 802:11 will now be modulated by the triangular wave fed back, as illustrated in the timing diagram fig. IX-14.

The output frequency controlling TS 801, TS 802 is thus constant but the duty factor may vary.

12.2.2. Overload protection

If the load current increases to about 2.7 A, the voltage drop across R 816 will be great enough to open TS 804. Then TS 803 will start conducting and a voltage proportional to the increase of load is fed to the inverting input 4 of regulator IC 802, which will limit the output current to a preset value.

If the load is increasing yet more, the output voltage decreases but the current is constant.

At shortcircuit, the voltage will approach zero and the ripple frequency be audible.

12.2.3. Overvoltage protection

If the + 5 V output voltage increases to exceed the zener voltage of GR 804 and the trigger voltage of TS 810, the pnpn switch TS 810 will turn on and provide a gate signal to crow-bar thyristor GR 805. The output line will then be short-circuited and the output voltage about 1 V.

Simultaneously, the current limiter arrangement will reduce the output current to the short-circuit level (2.7 A). If an occasional disturbance of sufficient duration caused the excess voltage, the short-circuit is removed by operating the POWER ON switch. A persistent fault, e.g. short-circuit in TS 802, will switch on the crow-bar thyristor GR 805, which saves the integrated circuits in other sections of the counter to be damaged from the + 17 V applied to the 5 V line through TS 802. However, to protect also the crow-bar thyristor, the fuse VL 602 on unit U6 will also blow.

12.2.4. — 5.2 V circuit

Principally, this circuit is equal to the + 5 V circuit. The negative output voltage, however, makes the circuit arrangement somewhat different.

The output current at terminal IC 803:10 is level-shifted by TS 805. The current limit and overvoltage protection circuits are in principal the same as in the + 5 V supply section.

The inverting input of IC 803 is grounded and the output voltage fed back to the lower end of voltage divider R 822, 802, 803. The reference voltage is applied to the upper end. When the regulator is working, the dc level at the non-inverting input IC 803:5 will be zero.

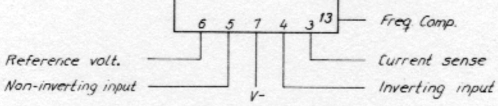


Fig. IX-13. Terminal designations

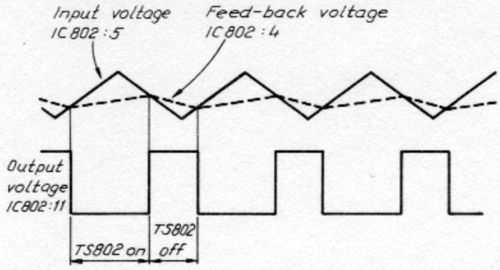


Fig. IX-14. Timing diagram

13. TIME BASE SYNCHRONIZER

Part of unit U4, refer to circuit diagram fig. XIV-8

In modes FREQ A or C, PERIOD A, TIME INTERVAL A TO B and CHECK, the 10 MHz internal clock signal from unit U6 is applied to gate IC 411:2 via terminal L of the circuit board connector.
The gate output IC 411:8 provides the input signal for decade counter IC 412 which operates as a scaler. The signal frequency is divided by 10 and is fed via switch SK 401 to the clock input 3 of the MOS circuit IC 413.
This circuit generates at terminal 1 an output signal whose frequency is determined by the address combination at inputs 11 . . . 14. The addresses are determined by the setting of the TIME BASE switch.
The output signal at terminal 1 of IC 413 is fed to the Data input of flip-flop IC 427 which is clocked by the inverted "B" signal generated by decade counter IC 412.
The output signal Q of flip-flop IC 427 will now have the same frequency as the output signal from MOS circuit IC 413 but will be synchronized with the clock signal.
The output jitter of IC 413 is thus eliminated.
The time base signal path goes further from IC 427:5 via IC 414, IC 409, IC 418, IC 424 to the gate flip-flop as detailed in the block diagram description.
In mode TIME INTERVAL AVG the number of averagings supplied from the Time Interval Averaging Synchronizer on unit U2 is applied to IC 411:1 via terminal 9 of the circuit board connector.
In modes PERIOD AVG and COUNT A the signal to be measured is applied to IC 411:10 via terminal 15 of the circuit board connector.
In mode RATIO A/B the B channel signal is applied to IC 411:5 via terminal 17 of the circuit board connector.
All of these alternative signals pass through the time base divider as described previously.
A special case, however, is the 100 ns setting of the TIME BASE switch. Then the signal at IC 411:8 goes directly to gate IC 414 via switch SK 401.

14. DISPLAY BLANKING

Refer to circuit diagram U1, fig. XIV-2, and timing diagram, fig. IX-15.

Leading zeros without decimal point are blanked in the PM 6650.
For this purpose, the 7-segment decoder/driver IC 103 is controlled by the blanking logic circuits IC 104 and IC 102.
Lines D and A of the Digit Scan Address information are applied to AND gate configuration GR 105 and GR 106. At decimal "9" the Digit Scan Address is 1001 which is closing the diodes of the AND gate. A positive pulse occurs at the base of TS 110, which provides a negative pulse (LOW) to inputs 13 and 4 of triple NAND gate IC 104, which is arranged as a bistable latch flip-flop. Outputs 12 and 6 go HIGH and are fed further to inputs 10 and 11 of the third NAND gate. Since input 9 is also HIGH (TS 111 off), output 8 goes LOW. This signal is applied to the Ripple Blanking Input (RBI) IC 103:5. Provided that the first digit now is 0 (as indicated in the timing diagram fig. IX-15 where we assume a display of 0000.05219) the Ripple Blanking Output (RBO) IC 103:4 will provide a LOW level to inputs 1, 2 and 3 of IC 104. The gate outputs 12 and 6 will maintain their HIGH states although inputs 13 and 4 are HIGH because the pulse at the base of TS 110 has disappeared. When the next digit data appears, in this case also a "0", the state of IC 104 will not be changed which means that the Ripple Blanking Input is still LOW. Outputs 9 through 14 of the decoder/driver IC 103 now have a high level so that all segments of the display are blanked.
Because the digit data from the 7th decade is also "0", no change occurs.
The 6th decade, however, is a "0" with decimal point (DP5). The Decimal Point Address B5, B6, B7 is already binary 101 which was determined by the previous setting of the TIME BASE and FUNCTION switches.
The DP Address is applied to Exclusive-OR gates IC 102 in which it is compared with the state of the Digit Scan Address. At the 6th decade, the Digit Scan Address is 0010 (decimal 2) which means that the IC 102 Comparator output goes HIGH. Transistor TS 111 turns on, input IC 104:9 goes LOW and output IC 104:8 goes HIGH. The Ripple Blanking Input IC 103:5 will also be HIGH which means that the Ripple Blanking Output IC 103:4 goes HIGH. The NAND gate flip-flop IC 104 will now be set to output state 001 (outputs 12, 6, 8), which will be maintained until a new LOW pulse arrives from TS 110.
The outputs of IC 103 decrease so that the relevant segments "a" through "f" of the display turn on. Transistor TS 112 controls the decimal point "h".
The scanning cycle now goes on until all decades are scanned. At decade No. 9, i.e. Digit Scan Address 9, the flip-flop IC 104 is reset to binary 110 and the cycle is repeated.
If one of the digits 1 . . . 9 appears before the decimal point, the Ripple Blanking Output IC 103:4 will go HIGH as soon as the Digit Data change from 0000 to another BCD digit. IC 104 will then be set to output state 001 before the Decimal Point Address arrives and turns IC 103 on.

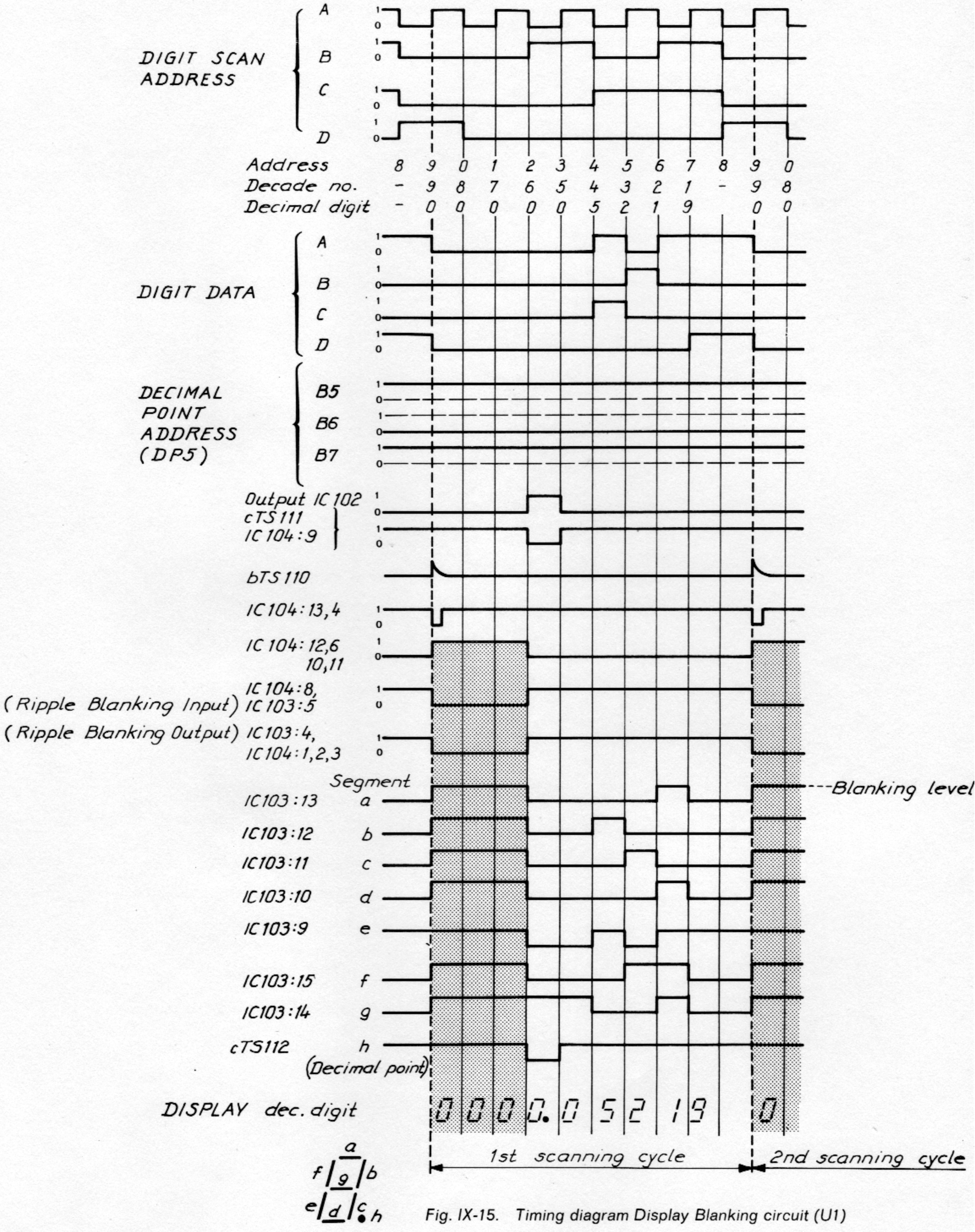


Fig. IX-15. Timing diagram Display Blanking circuit (U1)

X. PERFORMANCE CHECK

The tolerances mentioned in the following text apply to newly adjusted instruments only. The values may differ from those given in chapter III, Technical Data.

1. Survey of check points

Section	*Check performance of*	
3.	CHECK	**Functional check of measuring modes**
4.	DISPLAY TEST	
5.	RESET	
6.	DISPLAY TIME	
7.	MEMORY	
8.	FREQ C	
9.	FREQ A	
10.	RATIO A/B	
11.	PERIOD A	
12.	PERIOD AVG A	
13.	T.I. A TO B	
14.	T.I. AVG A TO B	
15.	COUNT A START/STOP	
16.	COUNT A GATED BY B	
17.	BURST	

Section	*Check performance of*
18.	1 MΩ, 50 Ω, SEP and COM switches
19.	Inputs A and B, frequency range and sensitivity
20.	Input C, frequency range and sensitivity
21.	10 MHz OUT
22.	TIME BASE OUT
23.	TRIGG. LEVEL OUT A and B
24.	GATE OPEN
25.	EXT STD 1 OR 10 MHz
26.	Temperature compensated crystal oscillator (TCXO)
27.	Oven-enclosed oscillator (PM 9680 A or PM 9681)
28.	Automatic gain control (AGC).

2. Test equipment

Instrument or device	*Required data*	*Recommended model*
Sampling oscilloscope	Bandwidth > 1 GHz	Philips PM 3400
Low frequency oscilloscope	Bandwidth 10 MHz 2 channels DC coupled	Philips PM 3250
Multimeter	Resistance range 1 MΩ	Philips PM 2412
T-piece BNC UG-274U	50 Ω	Philips PM 9067
Sweep generator	Sweep width 512 MHz CW mode Output amplitude 0.7 V_{rms} Slow sweep speed facility	Wavetek 2001
Passive probe	10 × attenuator 500 Ω impedance	Philips PM 9342
Frequency counter	Time base accuracy 10^{-8} or better	Philips PM 6645 with PM 9680
High frequency oscillator	Frequency 160 MHz Output amplitude 5 V_{p-p} into 50 Ω	General Radio Model GR 1363
Pulse generator	< 4 ns rise time Rep. frequency 1 MHz Amplitude 1.5 V_{p-p} Duty factor 0.5	Philips PM 5712
Coaxial cables	10 ns and 3 ns delay with BNC contacts, 50 Ω	RG 58 A/U
Resistive T-piece	Branch resistance 50 Ω	Philips PM 9584
Probe to BNC conversion bush		Included in Philips probe set PM 9350
Extender board set		

3. CHECK

3.1. Set the controls of the PM 6650:

FUNCTION	CHECK
MEMORY	depressed
DISPLAY TIME	mid-position

3.2. Rotate TIME BASE switch and check displayed value and GATE lamp:

TIME BASE	Read (±1 digit)	GATE lamp is on during
10 ns	0. No go	—
100 ns	0.10 GHz	100 ms
1 µs	100. MHz	100 ms
10 µs	100.0 MHz	100 ms
100 µs	100.00 MHz	100 ms
1 ms	100.000 MHz	100 ms
10 ms	100.0000 MHz	100 ms
100 ms	100.00000 MHz	100 ms
1 s	100000.000 kHz	1 s
10 s	0.0000 kHz	10 s
100 s	0.00000 kHz	100 s

4. DISPLAY TEST

4.1. Set the controls of the PM 6650:

FUNCTION	DISPLAY TEST
DISPLAY TIME	mid position
MEMORY	depressed

4.2. Rotate TIME BASE switch and check displayed value and GATE lamp:

TIME BASE	Read (±1 digit)	GATE lamp is on during
10 ns	0. ns	—
100 ns	1.0 μs	100 ms
1 μs	1.00 ms	100 ms
10 μs	1.000 s	100 ms
100 μs	1.0000 GHz	100 ms
1 ms	1.00000 MHz	100 ms
10 ms	1.000000 kHz	100 ms
100 ms	1.0000000 No go	100 ms
1 s	100000000. No go	1 s

5. RESET

5.1. Set the controls of the PM 6650:

FUNCTION	CHECK
TIME BASE	100 ns
MEMORY	depressed

5.2. Depress RESET push-button and check that display shows zero as long as the button is depressed.

5.3. Release RESET push-button and check that display reads 0.1 GHz.

6. DISPLAY TIME

6.1. Set the controls of the PM 6650:

FUNCTION	CHECK
DISPLAY TIME	fully CCW
TIME BASE	1 s
MEMORY	depressed

6.2. Rotate DISPLAY TIME potentiometer slowly from fully CCW to fully CW and note how flashing frequency of the GATE lamp decreases to approximately one flash every five seconds.

6.3. Pull DISPLAY TIME potentiometer and check that display shows 100000.000 kHz and that the GATE lamp is turned off as long as the knob is pulled.

7. MEMORY

7.1. Set the controls of the PM 6650:

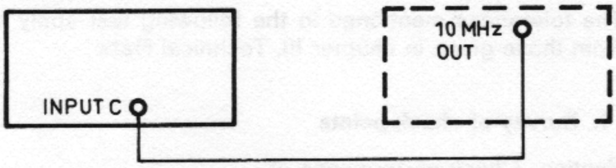
FUNCTION	CHECK
DISPLAY TIME	fully CCW
TIME BASE	1 s
MEMORY	released

7.2. Observe the display and check that counter is counting during 1 s and shows 100000.000 kHz during approximately 5 s.

7.3. Depress MEMORY push-button and check that display shows 100000.000 kHz permanently.

8. FREQUENCY C

Test set-up



Front panel PM 6650 *Rear panel PM 6650*

8.1. Set the controls of the PM 6650:

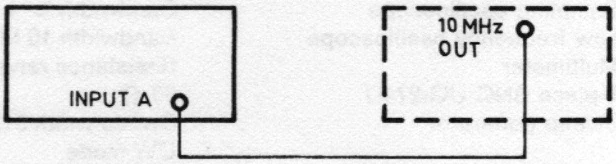
FUNCTION	FREQ C
TIME BASE	1 s
DISPLAY TIME	fully CCW
MEMORY	depressed

8.3. Check that display shows 10000.000 kHz and that the lamp at input C is on.

8.4. Turn FUNCTION switch to position FREQ A and check that the lamp at input C is turned off and the display shows zero.

9. FREQUENCY A

Test set-up



Front panel PM 6650 *Rear panel PM 6650*

9.1. Set the controls of the PM 6650:

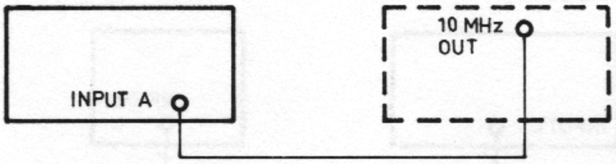
FUNCTION	FREQ A
TIME BASE	1 s
MEMORY	depressed
COUPL A	released
LEVEL A	pulled
50 Ω	depressed
ATT A	released
SEP	depressed

9.3. Check that the display shows 10000.000 kHz and that the lamp at input A is on.

9.4. Turn FUNCTION switch to position FREQ C and check that the display shows zero.

10. RATIO A/B

Test set-up



Front panel PM 6650 *Rear panel PM 6650*

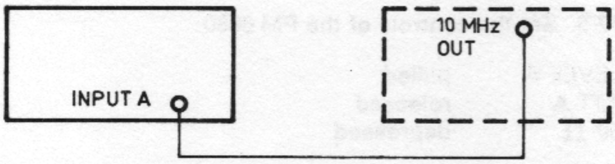
10.1. Set the controls of the PM 6650:

FUNCTION	RATIO A/B
MULTIPLIER	10^7
MEMORY	depressed
50 Ω	depressed
COM	depressed
LEVEL A & B	pulled
COUPL A & B	released
ATT A & B	released

10.3. Check that display shows 1.0 and that the lamps at inputs A and B are on.

11. PERIOD A

Test set-up



Front panel PM 6650 *Rear panel PM 6650*

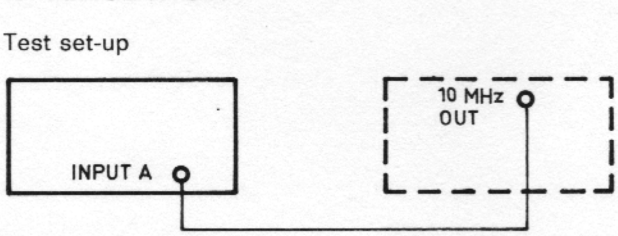
11.1. Set the controls of the PM 6650:

FUNCTION	PERIOD A
TIME BASE	10 ns
50 Ω	depressed
LEVEL A	pulled
COUPL A	released
ATT A	released
MEMORY	depressed

11.2. Check that display shows 0.10 µs and that lamp at input A is on.

12. PERIOD AVG A

Test set-up



Front panel PM 6650 *Rear panel PM 6650*

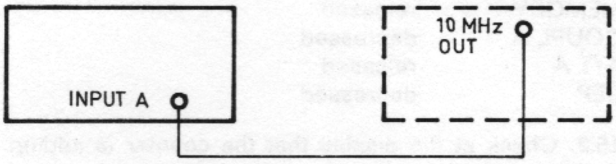
12.1. Set the controls of the PM 6650:

FUNCTION	PERIOD AVG A
MULTIPLIER	10^3
50 Ω	depressed
LEVEL	pulled
COUPL	released

12.2. Check that the display shows 100.00 ns and that lamp at input A is on.

13. T.I. A to B

Test set-up



Front panel PM 6650 *Rear panel PM 6650*

13.1. Set the controls of the PM 6650:

TIME BASE	10 ns
FUNCTION	T.I. A to B
DISPLAY TIME	mid position
COUPL A & B	depressed
COM	depressed
50 Ω	depressed
SLOPE A	released
SLOPE B	depressed
ATT A & B	released

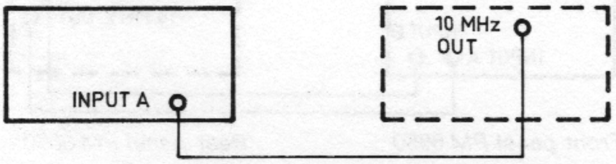
13.2. Turn LEVEL controls until display shows 0.04 µs.

13.3. Depress push-button SLOPE A and release push-button SLOPE B.

13.4. Check that display shoys 0.06 µs ±0.01 µs and that lamps at inputs A and B are on.

14. T.I. AVG A to B

Test set-up



Front panel PM 6650 *Rear panel PM 6650*

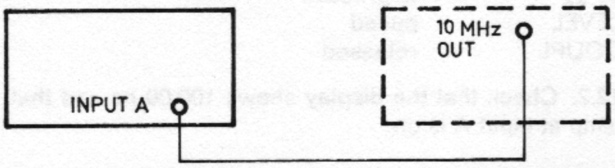
14.1. Set the controls of the PM 6650:

MULTIPLIER	10^3
FUNCTION	T.I. AVG A to B
DISPLAY TIME	mid position
COUPL A & B	depressed
COM	depressed
50 Ω	depressed
SLOPE A	released
SLOPE B	depressed
ATT A & B	released

14.2. Turn LEVEL potentiometers until display shows 40.00 ns. Check that lamps at inputs A and B are on.

15. COUNT A START/STOP

Test set-up



Front panel PM 6650 *Rear panel PM 6650*

FUNCTION	COUNT A
START/STOP	depressed
MEMORY	released
COUPL A	depressed
ATT A	released
SEP	depressed

15.2. Check at the display that the counter is adding the input pulses.
If necessary, adjust LEVEL A control.

15.3. Release push-button START/STOP and check at the display that the counter stops adding.

15.4. Depress RESET push-button and check that display shows zero.

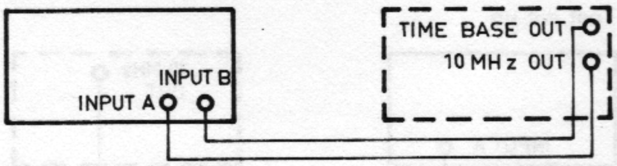
15.5. Depress MEMORY and START/STOP push-buttons. Check that GATE lamp is turned on and that display shows zero.

15.6. Release START/STOP push-button.
The display is now showing the amount of pulses counted in the time interval between depressing and releasing the START/STOP push-button.

15.7. Release MEMORY push-button. Check that display shows zero.

16. COUNT A GATED BY B

Test set-up



Front panel PM 6650 *Rear panel PM 6650*

16.1. Set the controls of the PM 6650:

FUNCTION	COUNT A
MULTIPLIER	10^7
50 Ω	depressed
COUPL A & B	depressed
SEP	depressed
ATT	released

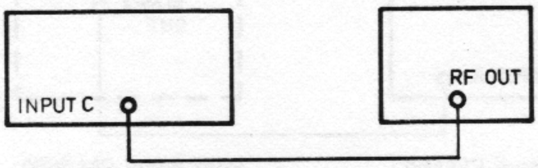
16.2. Adjust LEVEL B potentionemter until lamp at input B flashes with intervals of approximately 1 sec.

16.3. Depress MEMORY and GATED BY B push-button. Check that display shows 5000000 ± 10 digits.

16.4. Release MEMORY push-button and check at the display that the counter is adding the input pulses.

17. BURST

Test set-up



PM 6650 *CW generator*

17.1. Set the controls of the PM 6650:

FUNCTION	FREQ C
MEMORY	depressed
BURST	depressed
DISPLAY TIME	mid position
TIME BASE	1 ms

17.2. Set generator to amplitude 200mV$_{p-p}$ and frequency 100 MHz. The generator should operate in the CW mode.

17.3. Check that the GATE lamp is flashing and that the display shows the frequency of the input signal.

17.4. Disconnect the input signal from the counter and check that the GATE lamp stops flashing.
Check that the last readout remains on the display.

17.5. Set the controls of the PM 6650:

LEVEL A	pulled
ATT A	released
50 Ω	depressed

17.6. Connect the generator to input A.
Set FUNCTION switch to FREQ A and repeat steps 17.3. and 17.4.

18. 1 MΩ, 50 Ω, SEP and COM switches

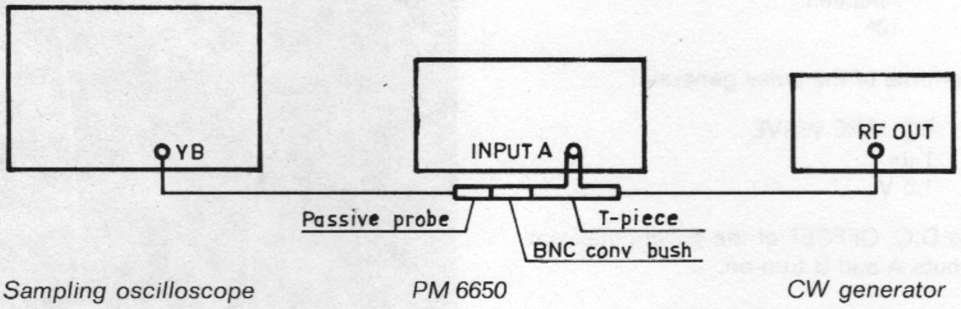
18.1. Depress push-buttons COUPL A and B of the PM 6650.

18.2. Check resistance between inputs A and B and between inputs and ground according to table.

Depress push-buttons				*Check resistance between A/B (Ω)*	*Check resistance between A/Ground (Ω)*	*Check resistance between B/Ground (Ω)*
1 MΩ	50 Ω	SEP	COM			
×		×		≈ 2 M	≈ 1 M	≈ 1 M
×			×	0	≈ 500 k	≈ 500 k
	×	×		≈ 100	≈ 50	≈ 50
	×		×	0	≈ 50	≈ 50

19. Inputs A and B, frequency range and sensitivity check

Test set-up



19.1. Set the generator to frequency 160 MHz and amplitude 200 $mV_{p\text{-}p}$.
The generator should operate in the CW mode.

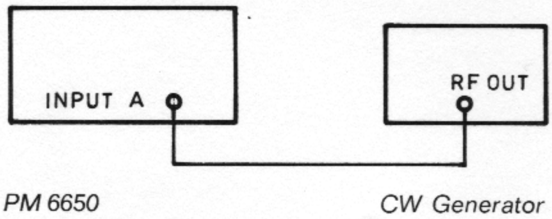
19.2. Set the controls of the sampling oscilloscope to 2 ns/cm and 2 mV/cm.

19.3. Set the controls of the PM 6650:

50 Ω	depressed
SEP	depressed
LEVEL A	pulled
LEVEL B	pulled
TIME BASE	10 ms
FUNCTION	FREQ A
COUPL A	DC
COUPL B	DC

19.4. Observe the oscilloscope display and adjust amplitude control of generator until signal becomes 140 $mV_{p\text{-}p}$. Check that counter displays approximately 160 MHz.
Depress push-button SLOPE A of the PM 6650 and check that display still shows approximately 160 MHz.

19.5. Change test set-up:



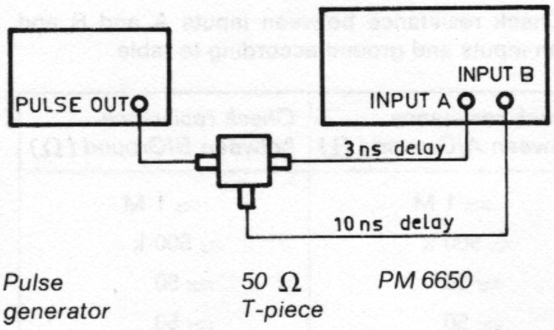
19.6. Set the controls of the PM 6650:

FUNCTION	RATIO A/B
MULTIPLIER	10^7
MEMORY	depressed
50 Ω	depressed
COM	depressed
LEVEL A & B	pulled
COUPL A & B	released
ATT A & B	released

19.7. Set the generator to frequency 10 MHz and amplitude 140 $mV_{p\text{-}p}$.
The generator should operate in the CW mode.

19.8. Check that the display shows 1.0 and that the lamps at input A and B are on.

19.9. Change test set-up:



19.10. Set the controls of the PM 6650:

FUNCTION	T.I. AVG A to B
LEVEL A & B	pulled
COUPL A & B	depressed
50 Ω	depressed
SEP	depressed
SLOPE A & B	released
MULTIPLIER	10^6

19.11. Set the controls of the pulse generator:

Mode	SQUARE WAVE
REP. TIME	1 μs
AMPLITUDE	1.5 V

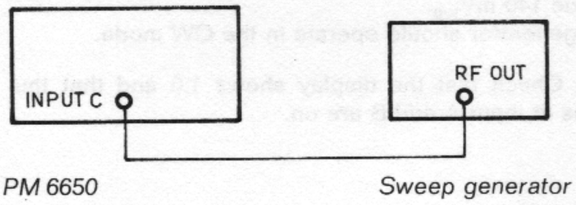
19.12. Adjust the D.C. OFFSET of the pulse generator until lamps at inputs A and B turn on.

19.13. Check that display shows 7 ns ± 1 ns.

19.14. Depress SLOPE A and B of the PM 6650 and check that display shows 7 ns ± 1 ns.

20. Input C, frequency range and sensitivity check

Test set-up



20.1. Set the controls of the PM 6650:

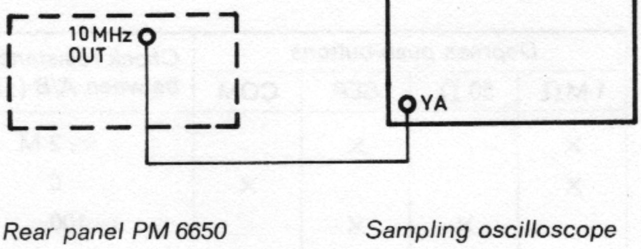
FUNCTION	FREQ C
TIME BASE	10 ms
DISPLAY TIME	CCW

20.2. Set the sweep generator to sweep width 512 MHz and amplitude 28 $mV_{p\text{-}p}$.
The sweep generator should operate in slow sweep speed mode.

20.3. Observe the display and lamp at input C and start the sweep generator.
Check that the counter is counting steadily up to 512 MHz and that the lamp is on permanently.

21. 10 MHz OUT

Test set-up



21.1. Set the sampling oscilloscope to 100 mV/cm and 20 ns/cm.

21.2. Check that oscilloscope displays a signal with waveform and amplitude similar to figure X-1.

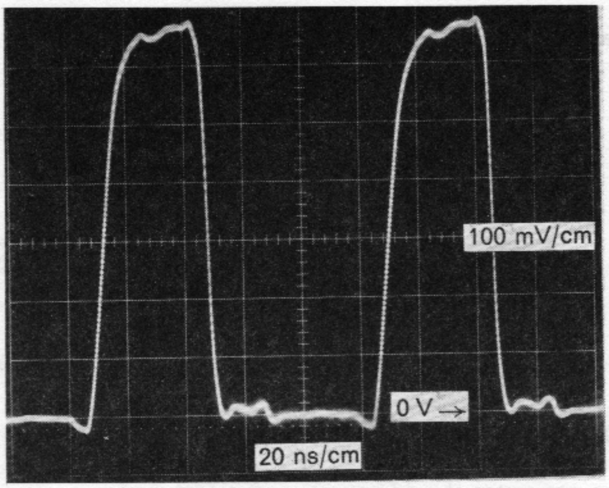
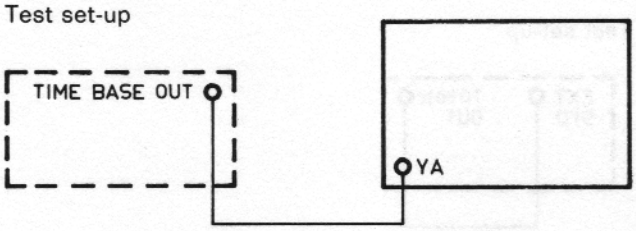


Fig. X-1. "10 MHz OUT" signal

22. TIME BASE OUT

Test set-up



Rear panel PM 6650 *Sampling oscilloscope*

22.1. Set the controls of the PM 6650:

TIME BASE	100 ns
FUNCTION	PERIOD A

22.3. Check that waveform and period time are similar to figure X-2.

22.4. Set TIME BASE switch to different positions and check that oscilloscope shows the set period time.

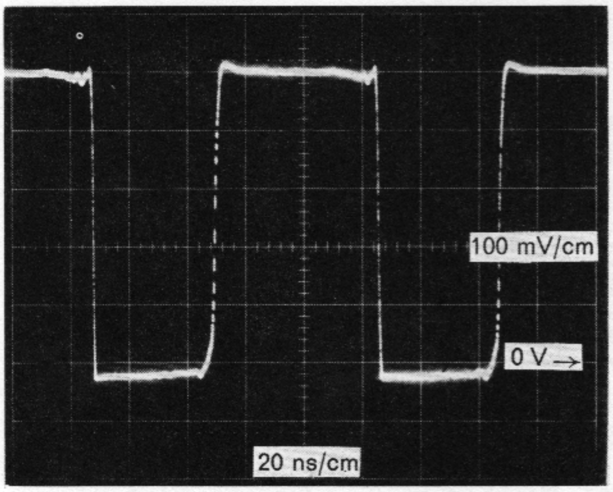
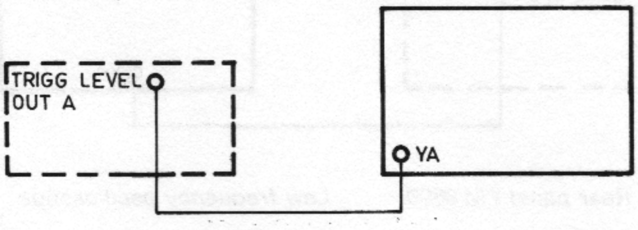


Fig. X-2. "TIME BASE OUT" signal

23. TRIGG LEVEL OUT A and B

NOTE: When measuring the trigger level with e.g. a high-ohmic DVM, the voltage is + 3 V (CW) to — 3 V (CCW).

Test set-up



Rear panel PM 6650 *Sampling oscilloscope*

23.1. Set LEVEL A control to position 0. Check at the oscilloscope that the d.c. level is 0 V.

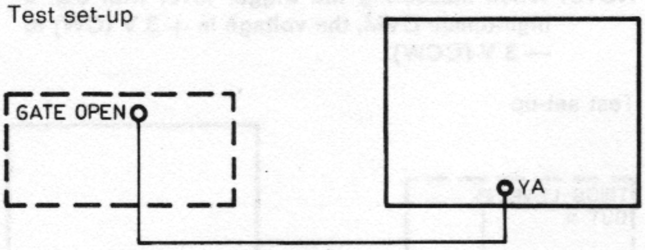
23.2. Turn LEVEL A control fully CW.
Check at the oscilloscope that the d.c. level is about + 80 mV.

23.3. Turn LEVEL A control fully CCW.
Check at the oscilloscope that the d.c. level is about — 80 mV.

23.4. Connect oscilloscope to TRIGG LEVEL OUT B at the rear panel of PM 6650 and repeat steps 23.1. to 23.3., this time adjusting the LEVEL B control.

24. GATE OPEN

Test set-up



Rear panel PM 6650 *Low frequency oscilloscope*

24.1. Set the controls of the PM 6650:

TIME BASE	1 ms
FUNCTION	FREQ A
BURST	released
DISPLAY TIME	CCW

24.2. Set the controls of the low frequency oscilloscope:

TRIGG	+
COUPL	d.c.

24.3. Check that oscilloscope displays waveform and amplitude similar to figure X-3 and that duration is 1 ms.

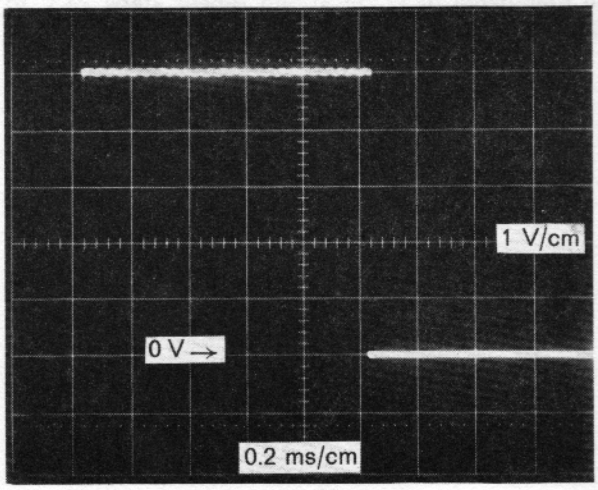
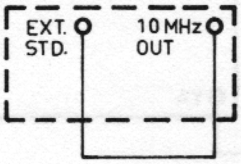


Fig. X-3. "GATE OPEN" signal

25. EXT STD 1 OR 10 MHz

Test set-up



Rear panel PM 6650

25.1. Set switch SK 601, INT. STD/EXT. STD., located on the mother-board U6, to position 2, EXT. STD.

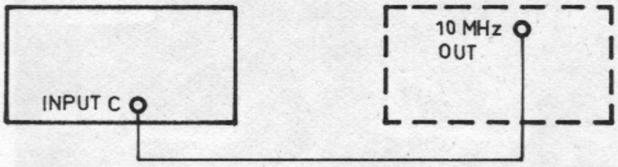
25.2. Set the controls of the PM 6650:

FUNCTION	CHECK
TIME BASE	1 ms

25.3. Check that display shows 100.000 MHz.

26. Temperature compensated crystal oscillator (TCXO)

Test set-up



PM 6650 *Rear panel PM 6630 or PM 6645*

26.1. This check requires a frequency standard having an accuracy of 10^{-8}.
The oven-enclosed oscillator of the PHILIPS counters PM 6630 A or PM 6645 meets this requirement.
The check should preferably be made at an ambient temperature of + 25° C.

26.2. Set the controls of the PM 6650:

FUNCTION	FREQ C
TIME BASE	1 s

26.3. Check that the display shows 10000.0000 kHz plus or minus the Δ f printed on the housing of the TCXO.

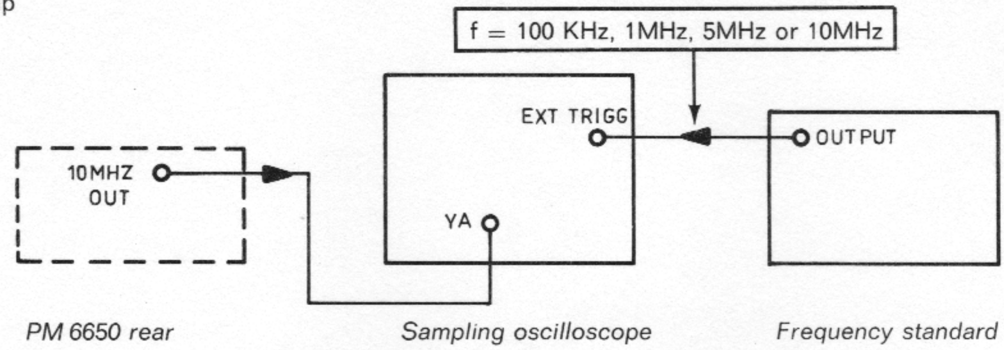
26.4. Refer to chapter XI, section 11.3., for adjustment instructions.

27. Oven-enclosed oscillator (type PM 9680 A or PM 9681)

27.1. This check requires a frequency standard having an accuracy of 10^{-10} or better.

NOTE: The oscillator must have been operating continuously for at least 72 h before any check is made.

Test set-up



27.2. Observe the movement of the displayed waveform:

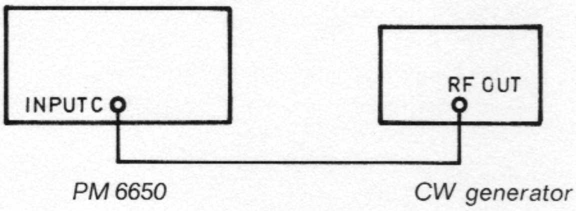
Waveform moves	*Oscillator frequency*
→	too low
←	too high

27.3. Refer to chapter XI, section 12.3. for calibration instruction.

---

28. Automatic gain control

Test set-up



28.1. Place unit U3 on an extender board.

28.2. Disconnect the input signals to the PM 6650 and connect the multimeter between ground and terminal 6 of IC 301.

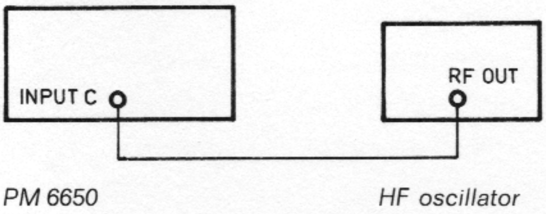
28.3. Check that the amplitude is about 11 V.

28.4. Set the generator to 100 MHz and amplitude about 10 $mV_{p\text{-}p}$.
The generator should operate in the CW mode.

28.5. Observe the reading of the multimeter and increase slowly the amplitude of the input signal. Check that the deflection of the multimeter decreases as the amplitude of the input signal increases.

28.6. Connect sampling oscilloscope to the collector of TS 306. Increase signal amplitude of the generator. Observe an amplitude increase of oscilloscope signal to a max. amplitude of approximately 700 $mV_{p\text{-}p}$.

28.7. Change test set-up:



28.8. Set the oscillator to about 100 MHz. Connect sampling oscilloscope to BU 301 of the PM 6650 and adjust amplitude control of oscillator until amplitude of oscilloscope signal is about 0.5 $V_{p\text{-}p}$.

28.9. Connect oscilloscope to point R 303/C 302. Check that amplitude is about 0.3 $V_{p\text{-}p}$.

28.10. Connect oscilloscope to BU 301 and increase amplitude of oscillator signal until amplitude of oscilloscope signal is about 5 $V_{p\text{-}p}$.

28.11. Connect the oscilloscope to point R 303/C 302. Check that the amplitude is about 1.5 $V_{p\text{-}p}$.

XI. INTERNAL CHECKS AND ADJUSTMENTS

The tolerances mentioned in the following text apply to newly adjusted instruments only. The values may differ from those given in chapter III, Technical Data.

NOTE: Always check the d.c. supply voltages before any adjustments are made!

1. Checking and adjusting points

Use fold-out page fig. XI-1 to identify location of trimmers.

Check point	*Adjust*
3. D.C. VOLTAGES	R 802, R 801, R 909
4. D.C. BALANCE CHANNELS A AND B	R 719, R 747
5. TRIGGER LEVEL CHANNELS A AND B	R 219, R 252
6. HYSTERESIS COMPENSATION CHANNELS A AND B	R 275, R 219, R 267, R 252
7. FREQUENCY COMPENSATION CHANNELS A AND B	C 702, C 712
8. LEVEL INDICATOR CHANNEL C	R 349
9. MULTIPLIER	C 338, C 341, C 345, C 350
10. HIGH FREQUENCY DECADE	R 523, R 514, R 508
11. TCXO	C 604
12. OVEN-ENCLOSED OSCILLATOR	PM 9680 A, PM 9681

2. Test equipment

Instrument or device	*Required data*	*Recommended model*
Digital multimeter	10—250 V d.c. ± 0.1 %	Philips PM 2421
T-piece BNC	50 Ω	Philips PM 9067
CW generator	Frequency 520 MHz Amplitude 150 mV_{p-p}	Wavetek Model 2001
Low frequency oscilloscope	Bandwidth 10 MHz 2 channels	Philips PM 3250
Sine wave generator	Frequency 3 kHz Amplitude 800 mV_{p-p}	Philips PM 5126
Pulse generator	Rep. time 1 s—20 μs Duty factor 0.5 Amplitude 0.5—5 V_{p-p}	Philips PM 5712
Coaxial coupling capacitor		General Radio type GR 874-K
High frequency oscillator	Frequency 160 MHz Output amplitude 5 V_{p-p} into 50 Ω	General Radio Model GR 1363
Attenuator	Passive 10 MΩ, 10 ×	Philips PM 9350
Probe to BNC conversion bush		Included in Philips probe set PM 9350
Extender board set		

3. D.C. voltages

3.1. Allow 10 minutes warming up of the PM 6650 before adjusting.

3.2. — 5.2 V.

3.3. Connect the digital multimeter to the top of R 831 and adjust R 802 until multimeter shows — 5.25 V.
Typical ripple is 50 mV_{p-p}.

3.4. + 5 V.

3.5. Connect the digital multimeter to the top of R 816 and adjust R 801 until multimeter shows + 5.05 V.
Typical ripple is 50 mV_{p-p}.

3.6 ± 12 V.

3.7. Connect the digital multimeter to the cathode of GR 904.
Adjust R 909 until multimeter shows + 12 V.

3.8. Connect multimeter to the anode of GR 906.
Check that the voltage is — 12 V ± 0.1 V.
Typical ripple is 5 mV_{p-p}.

3.9. + 210 V.

3.10. Connect the digital multimeter to BU 621 located at the bottom-card close to the mains transformer.

Check that the voltage is $+\ 210\ \text{V}\ {}^{+20}_{-10}\ \text{V}$.

CAUTION! Hazardous voltage!

4. D.C. balance channels A and B

4.1. *Channel A*

4.2. Set the controls of the PM 6650:

LEVEL A	pulled
50 Ω	depressed
FUNCTION	FREQ A

4.3. Disconnect all input signals to the PM 6650 and allow 10 minutes warming up. Connect the multimeter to the collectors of TS 205 and TS 206.

NOTE: To avoid self-oscillation it is recommended to connect a 1 kΩ resistor to each of the test-pins.

4.4. Adjust R 719 until the multimeter shows 0 V ± 5 mV.

4.5. *Channel B*

4.6. Pull LEVEL B control and connect the multimeter to the collectors of TS 216 and TS 218.

4.7. Adjust R 747 until multimeter shows 0 V ± 5 mV.

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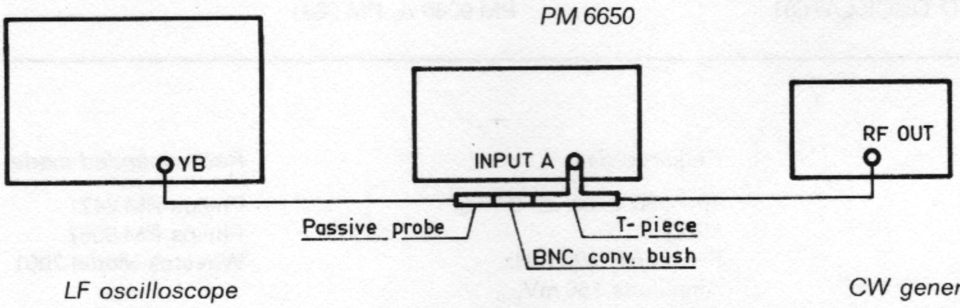
5. Trigger level channels A and B

5.1. *Channel A*



LF oscilloscope *CW generator*

5.2. Set the controls of the PM 6650:

LEVEL A	pulled
FUNCTION	FREQ A
50 Ω	depressed
TIME BASE	10 ms

5.3. Set the frequency of the generator to 10 MHz and the amplitude to 150 $\text{mV}_{\text{p-p}}$.
The generator should be operating in the CW mode.

5.4. Adjust R 218 until display shows 10 MHz. Decrease the amplitude of the signal from the generator until display shows wrong read-out.

5.5. Adjust R 218 further and decrease the input amplitude until display shows 10 MHz with the lowest possible input signal.

5.6. *Channel B*

Set the controls of the PM 6650:

LEVEL B	pulled
FUNCTION	Ratio A/B
COM	depressed
50 Ω	depressed
TIME BASE	10 ms

5.7. Set the amplitude of the generator to 150 $\text{mV}_{\text{p-p}}$ and adjust R 252 until display shows 1.0.

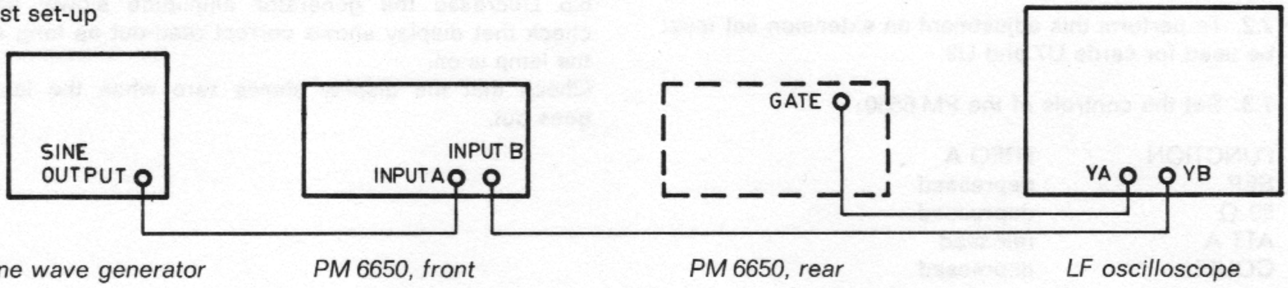
5.8. Decrease the amplitude of the input signal until display shows wrong read-out.

5.9. Adjust R 252 further and decrease the input amplitude until display shows 1.0 with the lowest possible input signal.

6. Hysteresis compensation channels A and B

6.1. *Channel A*

Test set-up



6.2. Set the controls of the PM 6650:

LEVEL A	pulled
LEVEL B	pulled
FUNCTION	T.I. A to B
1 MΩ	depressed
COM	depressed
SLOPE A	+
SLOPE B	—
DISPLAY TIME	CCW

6.3. Set the controls of the sine wave generator

AMPLITUDE	800 $mV_{p\text{-}p}$
FREQUENCY	3 kHz

6.4. Set the controls of the low-frequency oscilloscope:

YB	100 mV/div
YA	1 V/div
Slope	positive
Trigg	A
Trigger mode	d.c.

6.6. Adjust the displayed sine-wave symmetrically around zero by means of the Y-position control of the oscilloscope.

6.7. Adjust the X-position control until the positive edge of the gate pulse is visible.

6.8. Adjust R 275 until the sine-wave starts at 0 V. Refer to figure XI-2.

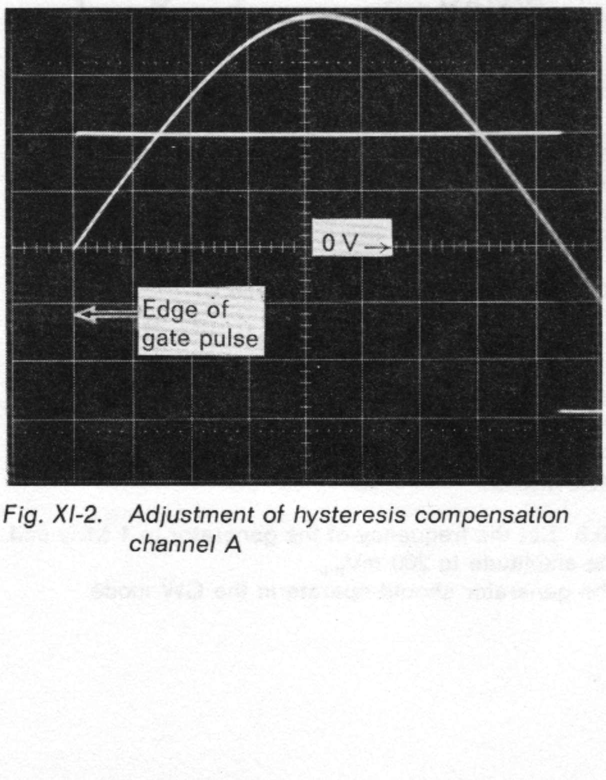


Fig. XI-2. Adjustment of hysteresis compensation channel A

6.9. Set SLOPE A to — and SLOPE B to +. Check that the sine wave still starts at 0 V. If not, adjust trigger level potentiometer R 218 slightly.

NOTE: If R 218 is adjusted it is necessary to check inputs A and B as detailed in chapter X, Performance Check, section 19.

6.10. Alternate between steps 6.8. and 6.9.

6.11. *Channel B*

6.12. Set SLOPE A of the PM 6650 to + and SLOPE B to —.
Set the low-frequency oscilloscope to negative slope.

6.13. Adjust the displayed sine-wave symmetrically around zero by means of the Y-position control of the oscilloscope.

6.14. Adjust the X-position control until the negative edge of the gate pulse is visible.

6.15. Adjust R 267 until the sine-wave starts at 0 V. Refer to figure XI-3.

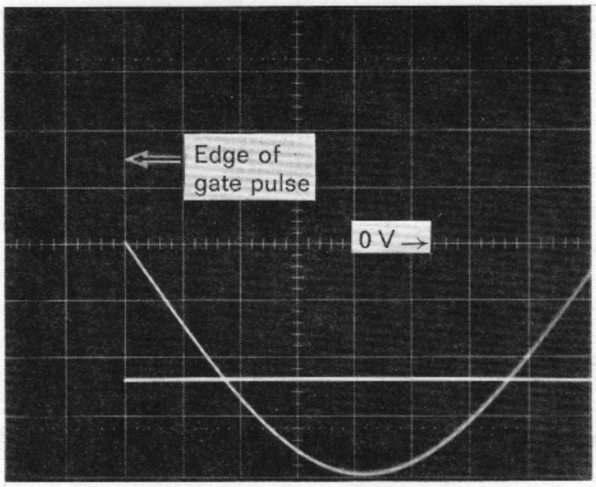


Fig. XI-3. Adjustment of hysteresis compensation channel B

6.16. Set SLOPE A to — and SLOPE B to + and check that the sine-wave still starts at zero. If not, adjust trigg. level potentiometer R 252 slightly and repeat step 6.15.

NOTE: If R 252 is adjusted it is necessary to check inputs A and B as detailed in chapter X, Performance Check, section 19.

6.17. Alternate between steps 6.15. and 6.16.

7. Frequency compensation channel A and B

7.1. *Channel A*

7.2. To perform this adjustment an extension set must be used for cards U7 and U2.

7.3. Set the controls of the PM 6650:

FUNCTION	FREQ A
SEP	depressed
50 Ω	depressed
ATT A	released
COUPL	depressed

7.4. Set the controls of the pulse generator

Mode	SQUARE WAVE
REP. TIME	20 μs
AMPLITUDE	0.5 V

7.5. Connect the low-frequency oscilloscope via a 10 × attenuator to the base of TS 705.
Adjust LEVEL A control to max.pulse amplitude.

7.6. Depress push-button ATT A of the PM 6650 and set the amplitude of the pulse generator to 5 $V_{p\text{-}p}$.
Adjust C 702 to best square-wave symmetry.

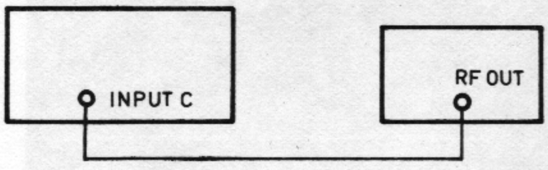
7.7. *Channel B*

7.8. Set the amplitude of the pulse generator to 0.5 $V_{p\text{-}p}$ and release push-button ATT B of the PM 6650.
Connect the low-frequency oscilloscope via a 10 × attenuator to the base of TS 711.
Adjust LEVEL B to max. amplitude.

7.9. Depress push-button ATT B of the PM 6650 and set the amplitude of the pulse generator to 5 $V_{p\text{-}p}$.
Adjust C 712 to best square-wave symmetry.

8. Level indicator channel C

Test set-up



PM 6650 *CW generator*

8.1. Set the generator to frequency 520 MHz and amplitude 25 $mV_{p\text{-}p}$.
The generator should operate in the CW mode.

8.2. Set the controls of the PM 6650:

TIME BASE	10 ms
FUNCTION	FREQ C

8.3. Adjust R 349 slowly until lamp at input C turns on and display shows 520 MHz.
Stop adjusting just when the lamp turns on and display shows correct read-out.

8.4. Repeat step 8.3. several times to make sure that R 349 is set to the exact position.

8.5. Decrease the generator amplitude slowly and check that display shows correct read-out as long as the lamp is on.
Check that the display shows zero when the lamp goes out.

9. Multiplier

9.1. Place unit U3 on an extender board.

9.2. Set the FUNCTION control of the PM 6650 to position CHECK, and connect the sampling oscilloscope via the coupling capacitor to the base of TS 314.

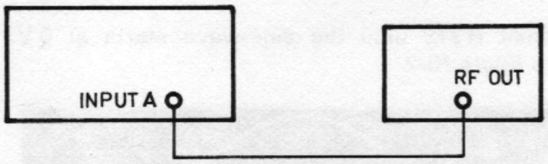
9.3. Adjust the signal to period time 20 ns and max. amplitude by means of C 338 and C 341.
Make sure that the period time really is 20 ns.

9.4. Connect the sampling oscilloscope to terminal 13 of IC 306. Adjust C 345 and C 350 to max. amplitude. Check that the period time is 10 ns and that display shows 100 MHz.

9.5. Connect the sampling oscilloscope to terminal 3 of IC 306 and check that the amplitude is between 0.8 —1 $V_{p\text{-}p}$.

10. High frequency decade

Test set-up



PM 6650 *CW generator*

10.1. Set the FUNCTION control of PM 6650 to position CHECK.
Adjust R 523, R 514 and R 508 until display shows 100 MHz.

10.2. Set the controls of the PM 6650:

FUNCTION	RATIO A/B
LEVEL A	pulled
LEVEL B	pulled
50 Ω	depressed
COM	depressed
MULTIPLIER	10^5

10.3. Set the frequency of the generator to 1 MHz and the amplitude to 200 $mV_{p\text{-}p}$.
The generator should operate in the CW mode.

10.4. Turn R 523 until display shows 1.0.
Next, turn R 523 clock-wise until display shows wrong read-out. Note the setting. Turn R 523 counter-clockwise until display shows wrong readout.
Note the setting.

10.5. Set R 523 between the clockwise and counter-clockwise settings.

10.6. Set the frequency of the generator to 520 MHz, set the FUNCTION control of the PM 6650 to position FREQ C and connect the generator to Input C of the PM 6650.

10.7. Adjust the AMPLITUDE control of the generator until the lamp at Input C turns on.
Turn R 514 and if necessary, R 508 until display shows 520 MHz.

10.8. Turn R 514 clockwise until display shows 520 MHz. Next, turn R 514 clockwise until display shows wrong readout. Note the setting. Turn R 514 counter-clockwise until display shows wrong readout. Note the setting.

10.9. Set R 514 between the clockwise and counter-clockwise settings.

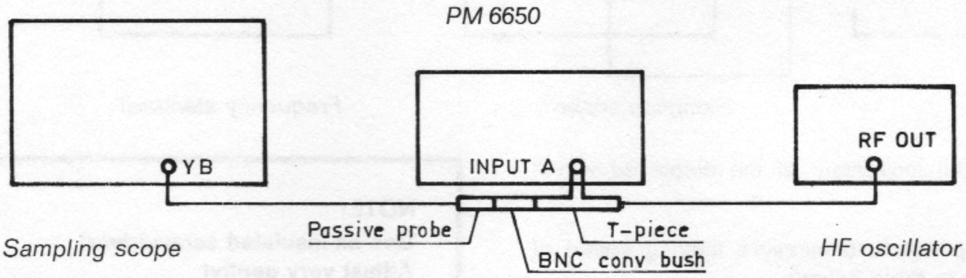
10.10. Repeat steps 10.8. and 10.9., but adjust R 508 in place of R 514.

10.11. Repeat steps 10.8. and 10.9. twice, first adjusting R 514 and then R 508.

10.12. Check performance of input C as detailed in chapter X, Performance Check, section 20.

10.13. Repeat step 10.12. with the amplitude control of the generator set to 2 V_{p-p}.

10.14. Change test set-up:



10.15. Set the FUNCTION control of PM 6650 to position FREQ A and depress push-button SEP.

10.16. Connect the H.F. oscillator and the sampling oscillator to Input A of the PM 6650 using the T-piece and 500 Ω probe and adapter.

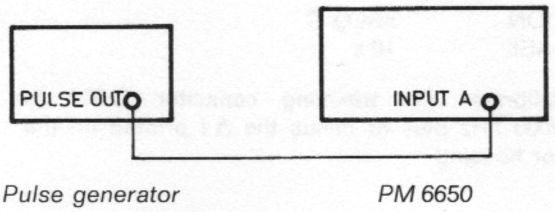
10.17. Set the frequency of the H.F. oscillator to 160 MHz and the amplitude to 1 V_{p-p}.

10.18. Check that the display shows correct readout and increase the amplitude of the HF oscillator until display shows wrong readout. Check that the amplitude exceeds 5 V_{p-p}. If the amplitude is 5 V_{p-p} or lower adjust R 508 *slightly*.

10.19. Decrease the amplitude until the display shows correct readout. Change SLOPE of the PM 6650. Check that display shows correct readout.

10.20. Change SLOPE again and repeat steps 10.17. and 10.18.

10.21. Change test set-up:



10.22. Set the controls of the PM 6650:

FUNCTION	COUNT A
MEMORY	released
AC/DC	depressed
LEVEL A	depressed

10.23. Set the controls of the pulse generator:

Mode	SQUARE WAVE
REP. TIME	1 s

10.24. Adjust LEVEL A control until the lamp at Input A starts flashing.

10.25. Depress push-button START of the PM 6650 and check that the counter is adding the pulses.

11. TCXO

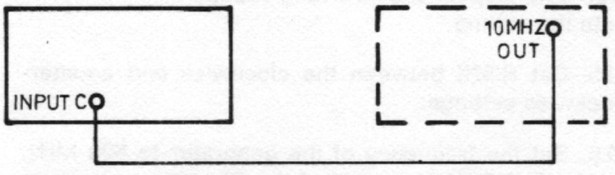
11.1. Use the oven-enclosed oscillator (accuracy 10^{-8} or better) of the Philips counters PM 6630, or PM 6645 as the frequency standard. Calibrate in an ambient temperature of +25° C.

11.2. Set the controls of the PM 6650:

FUNCTION	FREQ C
TIME BASE	10 s

11.3. Calibrate with trimming capacitor C 604 to 10000.0000 kHz plus or minus the Δ f printed on the oscillator housing.

Test set-up



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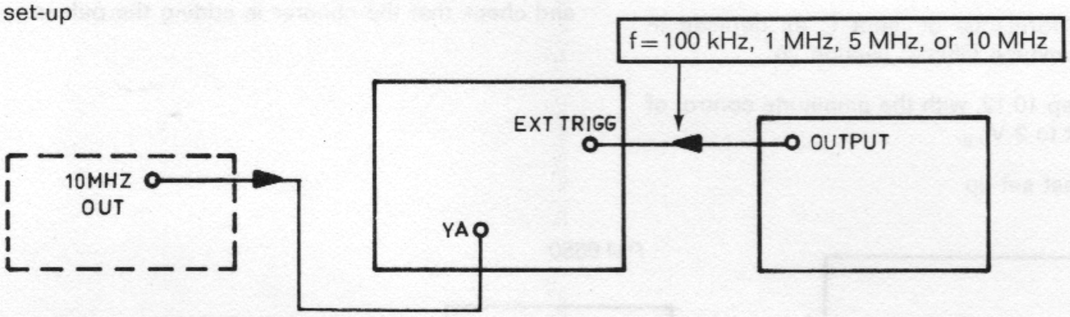
12. Oven-enclosed oscillator (type PM 9680 A or PM 9681)

NOTE:

The oscillator must have been operating continuously for at least 72 h before any adjustment is made.

12.1. This calibration requires a frequency standard having an accuracy of 10^{-10} or better.

Test set-up



12.2. Observe the movement of the displayed waveform.

12.3. Use a stop watch to measure moving speed of waveform (refer to table below).
The oscillator trimmer is accessible through the hole FREQ ADJ on the rear of PM 6650.

NOTE:

Use an insulated screwdriver!
Adjust very gently!
Recalibrate after 24 h of continuous operation.

Waveform moves	*Oscillator frequency*
→	too low
←	too high

Moving speed of waveform	*TIME/cm of oscilloscope*		
	1 µs/cm	*0.1 µs/cm*	*10 ns/cm*
1 cm/s	1×10^{-6}	1×10^{-7}	1×10^{-8}
1 cm/10 s	1×10^{-7}	1×10^{-8}	1×10^{-9}
1 cm/100 s	1×10^{-8}	1×10^{-9}	1×10^{-10}

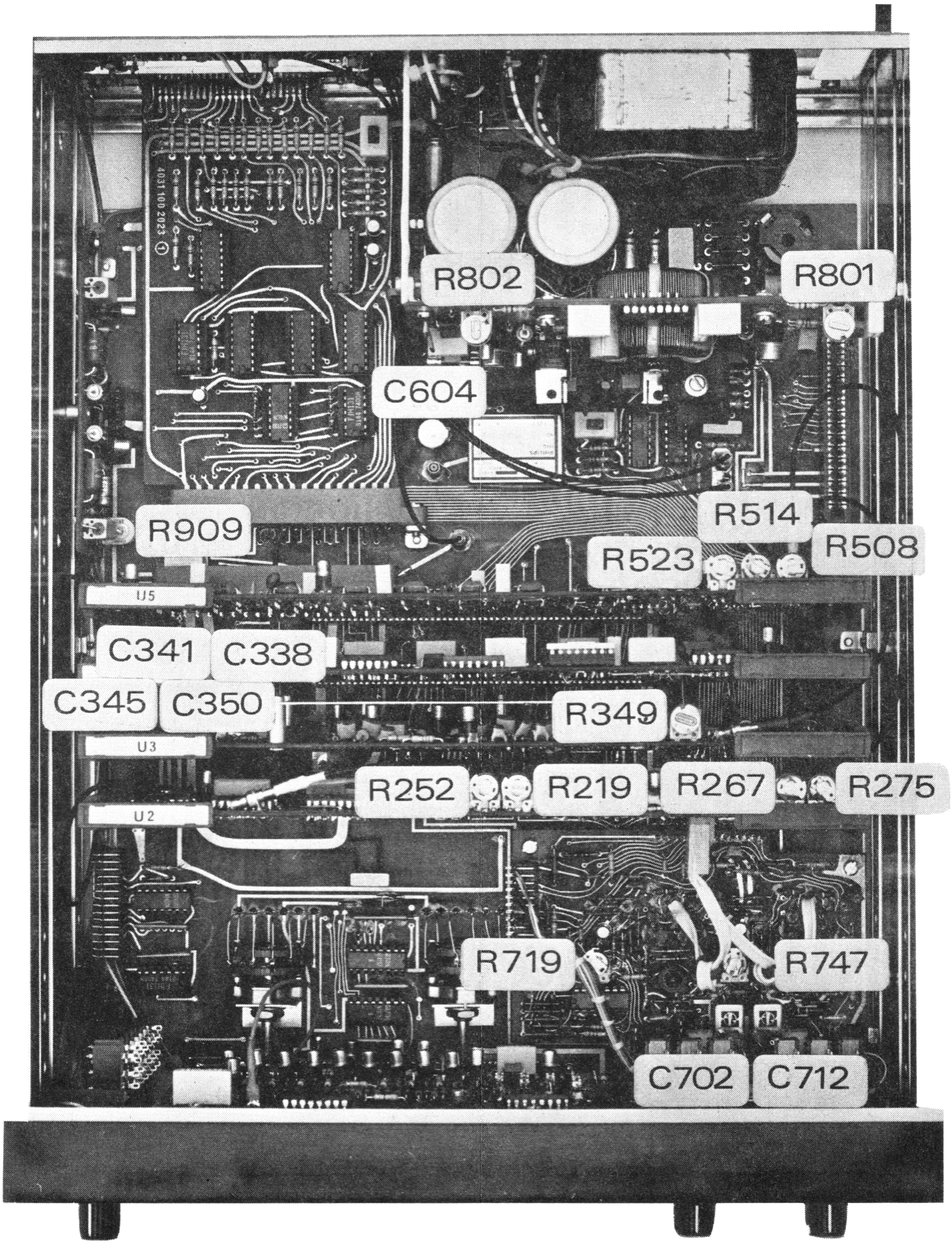


Fig. XI-1. Location of trimmers

XII. REPLACING PARTS

1. Textplate

1.1. Remove all knobs.

1.2. Turn the instrument upside down and remove the both screws located under the locking devices.

1.3. Remove the textplate by pulling it outwards.

2. Knobs

2.1. Remove cap.

2.2. Remove nut using a socket wrench.

2.3. Pull the knob off the spindle.

2.4. When replacing the knob make sure that the indication on the cap and knob are in the same position as before removal.

3. Oven oscillator PM 9680 A and PM 9681

Repairs on these oscillators may not be carried out by the local service organisations. In case of break-down the complete sealed oscillator should be sent to the factory for repair.
Factory address:
Philips Industrielektronik AB
S.C. Service Dept.
Fack
S-171 20 SOLNA 1 Sweden

4. Crystal oscillator TCXO

4.1. The plug-in type oscillator is secured to the mother board by self adhesive tape.

4.2. Remove cards U2, U3, U4 and U5.

4.3. Remove oscillator from card by bending with screw-driver.

5. 1 MΩ, 50 Ω, SEP and COM switches

5.1. Remove cards U2, U3, U4 and U5.

5.2. Remove the two screws securing the switch bracket to the front panel.

5.3. Loosen faulty switch from switch bracket by bending the four tags securing the switch to the bracket. Refer to fig. XII-1.

5.4 Unsolder and replace faulty switch with new one.

CAUTION:

The MOS circuits IC 413, IC 603 and IC 701 can be damaged by static electricity. Take the following precautions before any repair or replacement is made:
1. Do not wear nylon clothes.
2. Turn off the supply voltage before removing or inserting an IC.

6. RESET, MEMORY, BURST, START/STOP, GATED BY B, POWER switches and DISPLAY TIME potentiometer

6.1. Remove DISPLAY TIME knob.

6.2. Remove nut securing the DISPLAY TIME potentiometer to the front panel using a socket wrench.

6.3. Loosen flexible-card contact from mother board.

6.4. Remove the two screws securing switch bracket to front panel.

6.5. Lift switch bracket, potentiometer and flexible card from apparatus.

6.6. Unsolder and replace faulty item with new one.

7. LEVEL potentiometers

7.1. Remove knob.

7.2. Loose nut securing potentiometer to front panel using a socket wrench.

7.3. Unsolder and replace faulty potentiometer with new one.

7.4. Unsolder and replace faulty potentiometer with new one.

8. ATT. COUPL and SLOPE switches

8.1. Remove cards U2, U3, U4 and U5.

8.2. Remove the right-hand guide-rails for cards U 2, U 3, U 4 and U 5.
and U5.

8.3. Remove the two screws securing switch bracket to front panel.

8.4. Loosen faulty switch from switch bracket by bending the four tags securing the switch to the bracket. Refer to fig. XII-1.

8.5. Unsolder and replace faulty switch with new one.

9. Board U7

9.1. Remove two screws securing the board to the mother board.

9.2. Remove the right-hand guide-rail for card U2.

9.3. Lift card from apparatus.

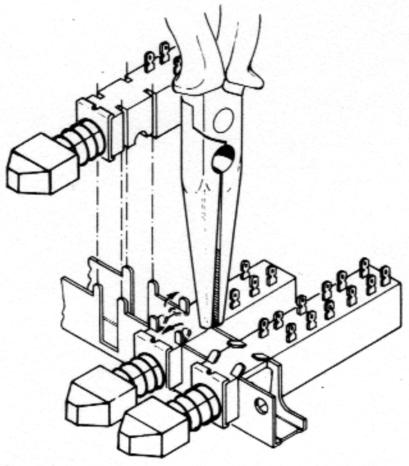


Fig. XII-1. Removing push-button switches

XIII. TROUBLESHOOTING

1. Voltages and waveforms

The d.c. voltages indicated in the circuit diagrams are typical and may vary slightly between instruments.
Unless otherwise stated the voltages are positive and related to earth. The test instrument can be analogue or digital with an input impedance of at least 40 kΩ/V.

IMPORTANT NOTE:

Voltages in the input circuit C (Unit U3) are measured with 10 MHz OUT (rear) applied to input C.
Voltages in unit U7 are measured with a 1 kΩ resistor in series with the test probe to prevent self-oscillations.

The waveforms recorded are placed next to the circuit board drawings. The testpoint (TP) reference is also indicated in the circuit diagram. If not otherwise stated, the oscillograms are recorded with a 50 MHz oscilloscope PM 3250 including passive 1:10 probe PM 9350.

2. Flow charts

The block diagrams belonging to chapter IX, Technical Description, provide a clear view of the signal path at each measuring mode.

XIV. PARTS LIST, UNIT ASSEMBLIES, CIRCUIT DIAGRAMS

1. General

The mechanical and electrical parts are listed per assembly, i.e. Front Panel Assy., Rear Panel Assy., Unit U1, Unit U2 etc.
The typical power ratings for Philips standard resistors are as follows:

Style	*Power (W)*	*Type*
CR 16	0.2	Carbon
CR 25	0.33	Carbon
CR 37	0.5	Carbon
MR 25	0.4	Metal film
MR 30	0.5	Metal film
MR 52	0.75	Metal film
PR 37	1.6	Metal film
PR 52	2.5	Metal film

2. Circuit diagrams

Measurement conditions for voltages indicated in the circuit diagrams are provided in chapter XIII, Trouble-shooting.

3. Alphabetical survey of controls, connectors and indicators

3.1. Controls

ATT. A	SK 12
ATT. B	SK 15
BURST	SK 4
COM/SEP	SK 19
COUPL A	SK 13
COUPL B	SK 16
DISPLAY TIME	R 1, SK 1
50 Ω/1 MΩ	SK 18
FUNCTION	SK 602
GATED BY B	SK 6
LEVEL A	R 2, SK 10
LEVEL B	R 3, SK 10
Mains voltage selector (rear)	SK 22
MEMORY	SK 3
1 MΩ, 50 Ω	SK 18
POWER	SK 7
RESET	SK 2
SEP/COM	SK 19
SLOPE A	SK 14
SLOPE B	SK 17
START/STOP	SK 5
TIME BASE/MULTIPLIER	SK 603

3.2. Connectors

EXT. STD input (rear)	BU 27
GATE OPEN output (rear)	BU 28
Input A	BU 704
Input B	BU 705
Input C	BU 1
LEVEL A OUT (front)	BU 4
LEVEL B OUT (front)	BU 5
Mains input (rear)	BU 21
SUB-UNIT (rear)	BU 22
10 MHz OUT (rear)	BU 24
TIME BASE OUT (rear)	BU 23
TRIGG. LEVEL OUT A (rear)	BU 25
TRIGG. LEVEL OUT B (rear)	BU 26

3.3. Indicators

GATE	GR 103
Input A	GR 2
Input B	GR 3
Input C	GR 1
OSC	GR 102
REMOTE	GR 104

1.FRONT PANEL ASSY.

1.1.MECHANICAL PARTS

Ordering code	Description	Item	Qty.
5322 456 14036	TEXT PLATE		1
5322 450 64051	WINDOW		1
5322 414 34076	SWITCH KNOB		2
5322 414 34083	CONTROL KNOB		3
5322 414 74014	COVER FOR KNOBS		5
5322 414 14011	PUSH-BUTTON		16
5322 267 10004	BNC SOCKET		1
5322 268 24045	MINIATURE JACK		2
5322 273 74006	ROTARY SWITCH	SK602 SK603	2
5322 276 14117	PUSH-BUTTON SWITCH		16
5322 267 64027	FEMALE CONNECTOR	U11/U6	1
5322 466 14126	FLEXIBLE CARD	U12	1
5322 267 64027	FEMALE CONNECTOR	U12/U6	1

1.2.ELECTRICAL PARTS

RESISTORS,VARIABLE

Ordering code	Description	Item	Qty.
5322 101 54004	POTMETER/SWITCH 100K LOG, 20%	R1/SK1	1
5322 101 44016	POTMETER/SWITCH 10K LIN, 20%	R2/SK2	1
5322 101 44016	POTMETER/SWITCH 10K LIN, 20%		1

LIGHT-EMITTING DIODE

Ordering code	Type	Item	Qty.
5322 130 34335	TIL209	GR11,12,13	3

2.REAR PANEL ASSY.

2.1.MECHANICAL PARTS

Ordering code	Description	Qty.
5322 256 40017	FUSE HOLDER	1
5322 277 20014	MAINS-VOLTAGE-CONVERSION SWITCH	1
5322 267 10004	BNC SOCKET	6
5322 265 30066	MAINS INPUT	1
5322 267 70014	SUB-UNIT CONNECTOR	1

2.2.ELECTRICAL PARTS

Ordering code	Description	Qty.
5322 146 14073	MAINS TRANSFORMER	1
4822 253 30017	FUSE,0,5A,DEL.(220V)	1
4822 253 30021	FUSE 1A DEL 115V	1

CAPACITORS

Ordering code	Farad	%	Volts	Item	Qty.
4822 121 20067	5N		250	C21	1
4822 121 20067	5N		250	C22	1
4822 121 40088	10N	10	250	C23	1
4822 121 40088	10N	10	250	C24	1

DIODES

Ordering code	Type	Item	Qty.
5322 130 34042	VARO VH248 RECTIFIER BRIDGE	GR21	1

3.UNIT U1

3.1.MECHANICAL PARTS

Ordering code	Description	Item	Qty.
5322 268 14029	FLAT CONN, PIN		17
5322 255 40089	TRANSISTOR HOLDER	TO18	15
5322 255 44025	IC HOLDER,16-PINS		2
	DISPLAY HOLDER	BU101	1

3.2.ELECTRICAL PARTS

DISPLAY AND LAMPS

Ordering code	Description	Item	Qty.
	DISPLAY	B101	1
4822 134 40167	LAMP (INDICATOR UNIT)		8

RESISTORS,FIXED

Ordering code	Ω	%	Watt	Item	Qty.
5322 116 54928	523K	1	MR30	R101	1
5322 116 54928	523K	1	MR30	R102	1
5322 116 54928	523K	1	MR30	R103	1
5322 116 54928	523K	1	MR30	R104	1
5322 116 54928	523K	1	MR30	R105	1
5322 116 54928	523K	1	MR30	R106	1
5322 116 54928	523K	1	MR30	R107	1
5322 116 54928	523K	1	MR30	R108	1
5322 116 54928	523K	1	MR30	R109	1
4822 110 63167	180K	5	CR25	R110	1
5322 116 54707	130K	1	MR25	R111	1
5322 116 54707	130K	1	MR25	R112	1
5322 116 54707	130K	1	MR25	R113	1
5322 116 54707	130K	1	MR25	R114	1
5322 116 54707	130K	1	MR25	R115	1
5322 116 54707	130K	1	MR25	R116	1
5322 116 54707	130K	1	MR25	R117	1
5322 116 54707	130K	1	MR25	R118	1
5322 116 54707	130K	1	MR25	R119	1
4822 110 63129	6,8K	5	CR25	R120	1
4822 110 63143	22K	5	CR25	R121	1
4822 110 63134	10K	5	CR25	R122	1
4822 110 63134	10K	5	CR25	R123	1
4822 110 63134	10K	5	CR25	R124	1
4822 110 63134	10K	5	CR25	R125	1
4822 110 63127	5,6K	5	CR25	R126	1
4822 110 63134	10K	5	CR25	R127	1
4822 110 63127	5,6K	5	CR25	R128	1
4822 110 63156	68K	5	CR25	R129	1
4822 110 63134	10K	5	CR25	R130	1
4822 110 63134	10K	5	CR25	R131	1
4822 110 63134	10K	5	CR25	R132	1
5322 116 50672	51,1K	1	MR25	R133	1
5322 116 54743	301K	1	MR25	R134	1
4822 110 63116	2,2K	5	CR25	R135	1
4822 110 63094	330	5	CR25	R136	1
4822 110 63107	1K	5	CR25	R137	1
4822 110 63094	330	5	CR25	R138	1
4822 110 63178	470K	5	CR25	R140	1
4822 110 63178	470K	5	CR25	R141	1
4822 110 63178	470K	5	CR25	R142	1
4822 110 63178	470K	5	CR25	R143	1
4822 110 63178	470K	5	CR25	R144	1
4822 110 63178	470K	5	CR25	R145	1
4822 110 63178	470K	5	CR25	R146	1
4822 110 63178	470K	5	CR25	R147	1
4822 110 63178	470K	5	CR25	R148	1
4822 110 63178	470K	5	CR25	R149	1

CAPACITORS,FIXED

Ordering code	Farad	%	Volts	Item	Qty.
4822 121 41161	0,1M	10	250	C101	1
5322 121 40323	0,1M	10	100	C102	1
4822 122 30128	4,7N	10	100	C103	1
4822 122 31175	1N	10	100	C104	1
4822 122 31116	2,2N	10	500	C105	1

DIODES

Ordering code	Type	Item	Qty.
5322 130 34335	TIL209 L.E.D	GR102	1
5322 130 34335	TIL209 L.E.D	GR103	1
5322 130 34335	TIL209 L.E.D	GR104	1
5322 130 30613	BAW62	GR105	1
5322 130 30613	BAW62	GR106	1

TRANSISTORS

Ordering code	Type	Item	Qty.
5322 130 44247	BSS68	TS101	1
5322 130 44247	BSS68	TS102	1
5322 130 44247	BSS68	TS103	1
5322 130 44247	BSS68	TS104	1
5322 130 44247	BSS68	TS105	1
5322 130 44247	BSS68	TS106	1
5322 130 44247	BSS68	TS107	1
5322 130 44247	BSS68	TS108	1

Ordering code	Type	Item	Qty.
5322 130 44247	BSS68	TS109	1
5322 130 40343	BC108B	TS110	1
5322 130 40343	BC108B	TS111	1
5322 130 40321	BSS38	TS112	1
5322 130 40348	BC178B	TS113	1
5322 130 40343	BC108B	TS114	1
4822 130 40855	BC337	TS115	1

INTEGRATED CIRCUITS

Ordering code	Type	Item	Qty.
5322 209 84159	SN74141N-SEL	IC101	1
5322 209 84639	SN74136N	IC102	1
5322 209 84641	DM8880N	IC103	1
5322 209 84534	SN7412N	IC104	1
5322 209 80236	SN74145N	IC105	1

4.UNIT U2

4.1.MECHANICAL PARTS

Ordering code	Description	Item	Qty.
5322 264 44032	MALE 5-P CONNECTOR	BU201	1
5322 267 14003	MIN.COAX CONNECTOR	BU202	1
5322 267 14003	MIN.COAX CONNECTOR	BU202	1
5322 255 40089	TRANSISTOR HOLDER	TO18	5
5322 255 40089	TRANSISTOR HOLDER	TO72	2
5322 255 44025	IC HOLDER FORIC208,- IC209,IC210		3

4.2.ELECTRICAL PARTS

RESISTORS,FIXED

Ordering code	Ω	%	Watt	Item	Qty.
4822 111 30069	39	5	CR16	R201	1
4822 111 30272	680	5	CR16	R202	1
4822 111 30265	2,2K	5	CR16	R203	1
4822 111 30324	100	5	CR16	R204	1
4822 111 30303	8,2K	5	CR16	R205	1
4822 111 30313	5,6K	5	CR16	R206	1
4822 111 30069	39	5	CR16	R207	1
4822 111 30272	680	5	CR16	R208	1
4822 111 30265	2,2K	5	CR16	R209	1
4822 111 30324	100	5	CR16	R210	1
4822 111 30272	680	5	CR16	R211	1
4822 111 30352	82	5	CR16	R212	1
4822 111 30352	82	5	CR16	R213	1
4822 111 30268	1,2K	5	CR16	R214	1
4822 111 30326	180	5	CR16	R215	1
5322 116 50527	33,2	1	MR25	R216	1
4822 111 30326	180	5	CR16	R217	1
5322 116 54513	332	1	MR25	R218	1
5322 111 30383	68	5	CR16	R220	1
5322 111 30383	68	5	CR16	R221	1
4822 111 30331	470	5	CR16	R222	1
5322 116 54522	432	5	MR25	R223	1
	820	5	CR16	R224	1
4822 111 30352	82	5	CR16	R225	1
4822 111 30327	220	5	CR16	R226	1
4822 111 30323	270	5	CR16	R227	1
4822 111 30324	100	5	CR16	R228	1
4822 111 30271	820	5	CR16	R229	1
4822 111 30069	39	5	CR16	R230	1
4822 111 30272	680	5	CR16	R231	1
4822 111 30313	5,6K	5	CR16	R232	1
4822 111 30272	680	5	CR16	R233	1
4822 111 30069	39	5	CR16	R234	1
4822 111 30265	2,2K	5	CR16	R235	1
4822 111 30303	8,2K	5	CR16	R236	1
4822 111 30265	2,2K	5	CR16	R237	1
4822 111 30324	100	5	CR16	R238	1
4822 111 30352	82	5	CR16	R239	1
4822 111 30324	100	5	CR16	R240	1
4822 111 30352	82	5	CR16	R241	1
4822 111 30352	82	5	CR16	R242	1
4822 111 30268	1,2K	5	CR16	R243	1
4822 111 30326	180	5	CR16	R244	1
5322 111 30383	68	5	CR16	R245	1
5322 111 30383	68	5	CR16	R246	1
4822 111 30331	470	5	CR16	R247	1
5322 116 54522	432	5	MR25	R248	1
5322 116 50527	33,2	1	MR25	R249	1
4822 111 30326	180	5	CR16	R250	1
5322 116 54513	332	1	MR25	R251	1
4822 111 30271	820	5	CR16	R253	1
4822 111 30328	220	5	CR16	R254	1
5322 111 30396	82	5	CR16	R255	1
4822 111 30323	270	5	CR16	R256	1
4822 111 30324	100	5	CR16	R257	1
4822 111 30271	820	5	CR16	R258	1
5322 116 54595	5,11K	1	MR25	R259	1
5322 116 54619	10K	1	MR25	R260	1
4822 110 63132	8,2K	5	CR25	R261	1
4822 111 30273	10K	5	CR16	R262	1
4822 111 30273	10K	5	CR16	R263	1
4822 111 30312	4,7K	5	CR16	R264	1
4822 111 30273	10K	5	CR16	R265	1
4822 111 30265	2,2K	5	CR16	R266	1
4822 111 30265	2,2K	5	CR16	R268	1
4822 111 30314	6,8K	5	CR16	R269	1
4822 111 30265	2,2K	5	CR16	R270	1
4822 111 30273	10K	5	CR16	R271	1
4822 111 30245	47	5	CR16	R272	1
4822 111 30273	10K	5	CR16	R273	1
4822 111 30265	2,2K	5	CR16	R274	1
4822 111 30273	10K	5	CR16	R276	1
4822 111 30312	4,7K	5	CR16	R277	1
4822 111 30273	10K	5	CR16	R278	1
4822 111 30273	10K	5	CR16	R279	1
4822 111 30273	10K	5	CR16	R280	1
4822 111 30273	10K	5	CR16	R281	1
4822 111 30348	27	5	CR16	R282	1
4822 111 30325	150	5	CR16	R283	1
4822 111 30325	150	5	CR16	R284	1
4822 111 30348	27	5	CR16	R285	1
4822 111 30325	150	5	CR16	R286	1
4822 111 30325	150	5	CR16	R287	1
4822 111 30273	10K	5	CR16	R288	1
4822 111 30273	10K	5	CR16	R289	1
4822 111 30271	820	5	CR16	R290	1
4822 111 30314	6,8K	5	CR16	R291	1
4822 111 30271	820	5	CR16	R292	1
4822 111 30323	270	5	CR16	R293	1
4822 110 63141	18K	5	CR25	R294	1
4822 111 30268	1,2K	5	CR16	R295	1
4822 111 30266	1,8K	5	CR16	R296	1
4822 111 30266	1,8K	5	CR16	R297	1
4822 111 30266	1,8K	5	CR16	R298	1
4822 110 63141	18K	5	CR25	R299	1
4822 111 30323	270	5	CR16	R1201	1
4822 111 30325	150	5	CR16	R1202	1
4822 111 30269	1K	5	CR16	R1203	1
4822 111 30309	560	5	CR16	R1204	1
4822 111 30323	270	5	CR16	R1205	1
4822 111 30268	1,2K	5	CR16	R1206	1
4822 111 30266	1,8K	5	CR16	R1207	1
4822 111 30272	680	5	CR16	R1208	1
4822 111 30331	470	5	CR16	R1209	1
4822 111 30245	47	5	CR16	R1210	1
4822 111 30327	220	5	CR16	R1211	1
4822 111 30245	47	5	CR16	R1212	1
4822 111 30331	470	5	CR16	R1213	1
4822 111 30328	330	5	CR16	R1214	1
4822 111 30325	150	5	CR16	R1215	1
4822 111 30352	82	5	CR16	R1216	1
4822 111 30067	33	5	CR16	R1217	1
4822 111 30067	33	5	CR16	R1218	1
4822 111 30268	1,2K	5	CR16	R1219	1
4822 111 30269	1K	5	CR16	R1220	1
4822 111 30269	1K	5	CR16	R1221	1
4822 111 30269	1K	5	CR16	R1222	1
4822 111 30329	390	5	CR16	R1223	1

RESISTORS,VARIABLE

Ordering code	Ω	%	Watt	Item	Qty.
5322 100 10117	2,2K	20	0,5W	R219	1
5322 100 10117	2,2K	20	0,5W	R252	1
5322 101 14067	4,7K	20	0,5W	R267	1
5322 101 14067	4,7K	20	0,5W	R275	1

CAPACITORS

Ordering code	Farad	%	Volts	Item	Qty.
4822 122 30043	10N	-20+80	63	C201	1
4822 122 30043	10N	-20+80	63	C202	1
4822 122 31054	10P	2	100	C203	1
4822 122 31054	10P	2	100	C204	1
4822 122 30043	10N	-20+80	63	C205	1
4822 122 30043	10N	-20+80	63	C207	1
4822 122 30043	10N	-20+80	63	C208	1
4822 122 30043	10N	-20+80	63	C209	1
4822 122 30043	10N	-20+80	63	C210	1
4822 122 31054	10P	2	100	C211	1
4822 122 31054	10P	2	100	C212	1
4822 122 30043	10N	-20+80	63	C213	1
4822 122 30043	10N	-20+80	63	C214	1
4822 122 30043	10N	-20+80	63	C215	1
4822 122 30043	10N	-20+80	63	C216	1
4822 122 30043	10N	-20+80	63	C217	1
4822 122 30043	10N	-20+80	63	C218	1
4822 122 30043	10N	-20+80	63	C219	1
5322 124 14039	0,68M		35	C220	1
4822 122 31074	56P	2	100	C221	1
4822 122 31074	56P	2	100	C222	1
5322 124 14076	22M	20	16	C223	1
5322 124 14076	22M	20	16	C224	1
4822 122 31054	10P	2	100	C225	1
4822 122 30043	10N	-20+80	63	C226	1
4822 124 20468	33M	-10+50	16	C227	1
4822 122 30043	10N	-20+80	63	C228	1
4822 124 20461	47M	-10+50	10	C229	1
4822 122 30043	10N	-20+80	63	C230	1
4822 124 20461	47M	-10+50	10	C231	1
4822 122 30043	10N	-20+80	63	C232	1
4822 124 20468	33M	-10+50	16	C233	1
4822 122 30043	10N	-20+80	63	C234	1
4822 122 30043	10N	-20+80	63	C235	1
4822 122 30043	10N	-20+80	63	C236	1
4822 122 30043	10N	-20+80	63	C237	1
4822 122 31058	15P	2	100	C238	1
4822 122 31058	15P	2	100	C239	1

INDUCTANCES

Ordering code	Description	Item	Qty.
4822 526 10025	FXC BEAD	L201	1
4822 526 10025	FXC BEAD	L202	1
5322 158 10052	CHOKE	L203	1
5322 158 10052	CHOKE	L204	1
5322 158 10052	CHOKE	L205	1
5322 158 10052	CHOKE	L206	1

DIODES

Ordering code	Type	Item	Qty.
5322 130 30613	BAW62	GR201	1
5322 130 30509	BZY88-C4V3	GR202	1
5322 130 30644	BA182	GR203	1
5322 130 30613	BAW62	GR204	1
5322 130 30509	BZX75-C2V1	GR205	1
5322 130 30644	BZY88-C4V3	GR206	1
5322 130 30613	BAW62	GR207	1
5322 130 30613	BAW62	GR208	1
5322 130 30667	BZX79-C9V1	GR209	1
5322 130 34049	BZX75-C2V1	GR210	1
5322 130 30264	BZX79-C4V7	GR211	1
5322 130 30264	BZX79-C4V7	GR212	1
5322 130 30613	BAW62	GR213	1
5322 130 30613	BAW62	GR214	1
5322 130 34062	FH1100	GR215	1
5322 130 34049	BZX75-C2V1	GR216	1

TRANSISTORS

Ordering code	Type	Item	Qty.
5322 130 44215	MPSL08	TS201	1
5322 130 44215	MPSL08	TS202	1
5322 130 40745	BFW92	TS203	1
5322 130 40745	BFW92	TS204	1
5322 130 40745	BFW92	TS205	1
5322 130 40745	BFW92	TS206	1
5322 130 40144	BC109C	TS207	1
5322 130 40745	BFW92	TS208	1
5322 130 40745	BFW92	TS210	1
5322 130 40745	BFW92	TS211	1
5322 130 44215	MPSL08	TS212	1
5322 130 44215	MPSL08	TS213	1
5322 130 40745	BFW92	TS214	1
5322 130 40745	BFW92	TS215	1
5322 130 40745	BFW92	TS216	1
5322 130 40745	BFW92	TS218	1
5322 130 40144	BC109C	TS219	1
5322 130 40745	BFW92	TS220	1
5322 130 40745	BFW92	TS221	1
5322 130 40745	BFW92	TS222	1
5322 130 40745	BFW92	TS223	1
5322 130 40348	BC178B	TS224	1
5322 130 40343	BC108B	TS225	1
5322 130 40407	2N2369	TS226	1
5322 130 40542	BFX89	TS227	1
5322 130 40542	BFX89	TS228	1

INTEGRATED CIRCUITS

Ordering code	Type	Item	Qty.
5322 209 84111	CA3086	IC201	1
5322 209 84111	CA3086	IC202	1
5322 209 84642	MC10216L	IC203	1
5322 209 84643	MC10102L	IC204	1
5322 209 84644	MC10211L	IC205	1
5322 209 84644	MC10211L	IC206	1
5322 209 84645	MC10125L	IC207	1
5322 209 84646	MC10131L	IC208	1
5322 209 84646	MC10131L	IC209	1
5322 209 84646	MC10131L	IC210	1
5322 209 84194	SN74123N	IC211	1
5322 209 84644	MC10211L	IC212	1
5322 209 84643	MC10102L	IC213	1
5322 111 94015	CSP07C1001K6 DALE	IC214	1
5322 111 94015	CSP07C1001K6 DALE	IC215	1
5322 111 94015	CSP07C1001K6 DALE	IC216	1
5322 111 94015	CSP07C1001K6 DALE	IC217	1
5322 111 94015	CSP07C1001K6 DALE	IC218	1

5.UNIT U3

5.1.MECHANICAL PARTS

Ordering code	Description	Item	Qty.
5322 255 40089	TRANSISTOR HOLDER	TO18	4
	DIST.PIECE UNDER TRANSISTORS		5
5322 267 14003	MIN.COAX CONNECTOR	BU301 BU302	2

5.2.ELECTRICAL PARTS

RESISTORS-FIXED

Ordering code	Ω	%	Watt	Item	Qty.
5322 116 54513	332	1	MR25	R301	1
5322 116 54513	332	1	MR25	R302	1
5322 116 54396	68	5	PR52	R303	1
5322 116 54396	68	5	PR52	R304	1
5322 116 50417	162	1	MR25	R305	1
4822 111 30312	4,7K	5	CR16	R306	1
5322 111 30291	68K	5	CR16	R307	1
4822 110 63114	1,8K	5	CR25	R308	1
4822 111 30309	560	5	CR16	R309	1
4822 111 30323	270	5	CR16	R310	1
4822 111 30323	2,7K	5	CR16	R311	1
4822 110 63129	6,8K	5	CR25	R312	1
4822 110 63116	2,2K	5	CR25	R313	1
4822 111 30347	10	5	CR16	R314	1
4822 110 53045	4,7	10		R315	1
4822 111 30309	560	5	CR16	R316	1
4822 111 30309	560	5	CR16	R317	1
4822 111 30323	270	5	CR16	R318	1
4822 111 30264	2,7K	5	CR16	R319	1
4822 111 30347	10	5	CR16	R320	1
4822 110 53045	4,7	10		R321	1
4822 111 30309	560	5	CR16	R322	1
4822 111 30309	560	5	CR16	R323	1
4822 111 30323	270	5	CR16	R324	1
4822 111 30264	2,7K	5	CR16	R325	1

Ordering code	Ω	%	Watt	Item	Qty.
4822 111 30347	10	5	CR16	R326	1
4822 110 53045	4,7	10		R327	1
4822 111 30309	560	5	CR16	R328	1
4822 111 30309	560	5	CR16	R329	1
4822 111 30323	270	5	CR16	R330	1
4822 111 30266	1,8K	5	CR16	R331	1
4822 111 30347	10	5	CR16	R332	1
4822 110 53045	4,7	10		R333	1
4822 111 30323	270	5	CR16	R334	1
4822 111 30309	560	5	CR16	R335	1
4822 111 30323	270	5	CR16	R336	1
4822 111 30266	1,8K	5	CR16	R337	1
4822 111 30347	10	5	CR16	R338	1
4822 110 53045	4,7	10		R339	1
4822 111 30323	270	5	CR16	R340	1
4822 110 63118	2,7K	5	CR25	R341	1
4822 110 63105	820	5	CR25	R342	1
4822 110 63107	1K	5	CR25	R344	1
4822 110 63125	4,7K	5	CR25	R345	1
4822 110 63134	10K	5	CR25	R346	1
4822 110 63094	330	5	CR25	R348	1
4822 110 63125	4,7K	5	CR25	R351	1
4822 110 63161	100K	5	CR25	R352	1
4822 110 63132	8,2K	5	CR25	R353	1
4822 110 63081	100	5	CR25	R354	1
4822 110 63101	560	5	CR25	R355	1
4822 110 63094	330	5	CR25	R356	1
4822 110 63178	470K	5	CR25	R359	1
4822 110 63105	820	5	CR25	R360	1
4822 110 63107	1K	5	CR25	R361	1
4822 110 63107	1K	5	CR25	R362	1
4822 110 63094	330	5	CR25	R363	1
4822 110 63089	220	5	CR25	R364	1
4822 110 63081	100	5	CR25	R365	1
4822 110 63125	4,7K	5	CR25	R366	1
4822 110 63129	6,8K	5	CR25	R367	1
4822 110 63103	680	5	CR25	R368	1
4822 110 63118	2,7K	5	CR25	R369	1

RESISTORS,VARIABLE

Ordering code	Ω	%	Watt	Item	Qty.
5322 101 14049	470	20	0,5W	R349	1

CAPACITORS,FIXED

Ordering code	Farad	%	Volts	Item	Qty
5322 122 30103	22N	-20+80	63	C301	1
5322 122 30103	22N	-20+80	63	C302	1
5322 122 30103	22N	-20+80	63	C303	1
4822 122 30043	10N	-20+80	63	C304	1
5322 122 30103	22N	-20+80	63	C305	1
4822 122 31175	1N	10	100	C306	1
5322 122 30103	22N	-20+80	63	C307	1
4822 122 31072	47P	2	100	C308	1
4822 122 30043	10N	-20+80	63	C309	1
5322 122 30103	22N	-20+80	63	C310	1
5322 122 30103	22N	-20+80	63	C311	1
4822 122 31058	15P	2	100	C312	1
4822 122 30043	10N	-20+80	63	C313	1
5322 122 30103	22N	-20+80	63	C314	1
5322 122 30103	22N	-20+80	63	C315	1
4822 122 31058	15P	2	100	C316	1
4822 122 30043	10N	-20+80	63	C317	1
5322 122 30103	22N	-20+80	63	C318	1
5322 122 30103	22N	-20+80	63	C319	1
4822 122 31058	15P	2	100	C320	1
4822 122 30043	10N	-20+80	63	C321	1
5322 122 30103	22N	-20+80	63	C322	1
4822 122 30043	10N	-20+80	63	C323	1
5322 122 30103	22N	-20+80	63	C324	1
4822 122 31173	220P	10	100	C325	1
4822 122 31058	15P	2	100	C326	1
4822 122 30043	10N	-20+80	63	C327	1
5322 122 30103	22N	-20+90	63	C328	1
5322 121 44002	0,01M	10	250	C330	1
4822 124 20468	33M	-10+50	16	C331	1
4822 124 20461	47M	-10+50	10	C332	1
4822 124 20468	33M	-10+50	16	C333	1
4822 122 31175	1N	10	100	C334	1
4822 122 31058	15P	2	100	C335	1
4822 122 31067	33P	2	100	C336	1
4822 122 31076	68P	2	100	C337	1

Ordering code	Farad	%	Volts	Item	Qty.
4822 122 31058	15P	2	100	C339	1
4822 122 30043	10N	-20+80	63	C340	1
4822 122 31058	15P	2	100	C342	1
4822 122 31043	3,9P	2	100	C343	1
4822 122 31047	5,6P	2	100	C344	1
4822 122 31067	33P	2	100	C346	1
4822 122 30043	10N	-20+80	63	C347	1
4822 122 30043	10N	-20+80	63	C348	1
4822 122 31067	33P	2	100	C349	1
4822 122 30043	10N	-20+80	63	C351	1
4822 122 30043	10N	-20+80	63	C352	1

CAPACITORS,VARIABLE

Ordering code	Farad	%	Volts	Item	Qty.
5322 125 50051	2-18P		300	C338	1
5322 125 50051	2-18P		300	C341	1
5322 125 50051	2-18P		300	C345	1
5322 125 50051	2-18P		300	C350	1

INDUCTANCES

Ordering code	Description	Item	Qty.
5322 158 10243	INDUCTANCE 0,1 MH	L301	1
5322 158 10243	INDUCTANCE 0,1 MH	L302	1
5322 158 10243	INDUCTANCE 0,1 MH	L303	1
5322 158 10243	INDUCTANCE 0,1 MH	L304	1
5322 158 10052	CHOKE	L305	1
5322 158 10052	CHOKE	L306	1
5322 158 10052	CHOKE	L307	1
4822 526 10025	FXC BEAD	L308	1
5322 158 10052	CHOKE	L309	1
5322 158 10052	CHOKE	L310	1

DIODES

Ordering code	Type	Item	Qty.
5322 130 34364	BA379	GR301	1
5322 130 34364	BA379	GR302	1
5322 130 34302	BA280	GR303	1
5322 130 34302	BA280	GR304	1
5322 130 34364	BA379	GR305	1
5322 130 34364	BA379	GR306	1
5322 130 34364	BA379	GR307	1
5322 130 30613	BAW62	GR308	1
5322 130 30613	BAW62	GR309	1
5322 130 34302	BA280	GR310	1
5322 130 34302	BA280	GR311	1
5322 130 34302	BA280	GR312	1
5322 130 34302	BA280	GR313	1
5322 130 30613	BAW62	GR316	1
5322 130 34365	1N5221B	GR317	1
5322 130 30759	BZX79-C5V6	GR318	1
5322 130 30613	BAW62	GR319	1
5322 130 30613	BAW62	GR320	1

TRANSISTORS

Ordering code	Type	Item	Qty.
5322 130 40348	BC178B	TS301	1
5322 130 40348	BC178B	TS302	1
5322 130 44179	BFR90	TS303	1
5322 130 44179	BFR90	TS304	1
5322 130 44179	BFR90	TS305	1
5322 130 44179	BFR90	TS306	1
5322 130 44179	BFR90	TS307	1
5322 130 40343	BC108B	TS308	1
5322 130 40348	BC178B	TS309	1
5322 130 40343	BC108B	TS310	1
5322 130 40348	BC178B	TS311	1
5322 130 44215	MPSL08	TS312	1
5322 130 40407	2N2369	TS313	1
5322 130 40407	2N2369	TS314	1

INTEGRATED CIRCUITS

Ordering code	Type	Item	Qty.
5322 209 84163	SN72741P	IC301	1
5322 209 84178	SN7400N	IC302	1
5322 209 80077	SN7410N	IC303	1
5322 209 84178	SN7400N	IC304	1
5322 209 84163	SN72741P	IC305	1
5322 209 84431	MC10116L	IC306	1
5322 111 94015	CSP08-S2 DALE	IC307	1

6,UNIT U4

6,1,MECHANICAL PARTS

Ordering code	Description	Item	Qty.
5322 255 40089	TRANSISTOR HOLDER	T018	2
5322 277 24003	SWITCH	SK401	1

6,2,ELECTRICAL PARTS

RESISTORS,FIXED

Ordering code	Ω	%	Watt	Item	Qty.
4822 110 63109	1,2K	5	CR25	R401	1
4822 110 63125	4,7K	5	CR25	R402	1
4822 110 63109	1,2K	5	CR25	R403	1
4822 110 63134	10K	5	CR25	R405	1
4822 110 63118	2,7K	5	CR25	R406	1
4822 110 63098	470	5	CR25	R407	1
4822 110 63107	1K	5	CR25	R408	1
4822 110 63107	1K	5	CR25	R409	1
4822 110 63045	4,7	5	CR25	R410	1
4822 110 63134	10K	5	CR25	R411	1
4822 110 63134	10K	5	CR25	R412	1
4822 110 63085	150	5	CR25	R414	1
4822 110 63081	100	5	CR25	R415	1
4822 110 63107	1K	5	CR25	R416	1
4822 110 63134	10K	5	CR25	R417	1
4822 110 63141	18K	5	CR25	R418	1
4822 110 63141	18K	5	CR25	R419	1
4822 110 63127	5,6K	5	CR25	R420	1
4822 110 63134	10K	5	CR25	R422	1
4822 110 63134	10K	5	CR25	R423	1
4822 110 63125	4,7K	5	CR25	R424	1
4822 110 63134	10K	5	CR25	R425	1
4822 110 63134	10K	5	CR25	R426	1

CAPACITORS,FIXED

Ordering code	Farad	%	Volts	Item	Qty.
5322 124 14053	22M		16	C401	1
4822 122 31165		10	100	C402	1
5322 121 40323	0,1M	10	100	C403	1
5322 124 14053	22M		16	C404	1
4822 124 20468	33M	-10+50	16	C405	1
4822 124 20461	47M	-10+50	10	C406	1
5322 121 40323	0,1M	10	100	C407	1
5322 121 40323	0,1M	10	100	C408	1
5322 121 40323	0,1M	10	100	C409	1
5322 121 40323	0,1M	10	100	C410	1
5322 121 40323	0,1M	10	100	C411	1
5322 121 40323	0,1M	10	100	C412	1
5322 124 14039	0,68M	-20+50	35	C413	1
4822 122 30043	10N	-20+80	63	C414	1

INDUCTANCES

Ordering code	Description	Item	Qty.
5322 158 10052	CHOKE	L401	1
5322 158 10052	CHOKE	L402	1

DIODES

Ordering code	Type	Item	Qty.
5322 130 30613	BAW62	GR401	1
5322 130 30613	BAW62	GR402	1
5322 130 30613	BAW62	GR403	1
5322 130 30613	BAW62	GR404	1
5322 130 30613	BAW62	GR405	1

TRANSISTORS

Ordering code	Type	Item	Qty.
5322 130 44104	BC328	TS401	1
5322 130 40348	BC178B	TS402	1

INTEGRATED CIRCUITS

Ordering code	Type	Item	Qty.
5322 209 80148	SN7404N	IC401	1
5322 209 80148	SN7404N	IC402	1
5322 209 84178	SN7400N	IC404	1
5322 209 84178	SN7400N	IC405	1
5322 209 80077	SN7410N	IC406	1
5322 209 80077	SN7410N	IC407	1
5322 209 84227	SN7402N	IC408	1
5322 209 84227	SN7402N	IC409	1
5322 209 80148	SN7404N	IC410	1
5322 209 84181	SN7454N	IC411	1
5322 209 80072	SN7490N	IC412	1
5322 209 84647	MK5009P MOSTEK	IC413	1
5322 209 84286	SN7551N	IC414	1
5322 209 84183	SN74574N	IC415	1
5322 209 84049	SN7413N	IC416	1
5322 209 84194	SN74123N	IC417	1
5322 209 84178	SN7400N	IC418	1
5322 209 80144	SN7483N	IC419	1
5322 209 84178	SN7400N	IC420	1
5322 209 84279	SN7408N	IC421	1
5322 209 80077	SN7410N	IC422	1
5322 209 84178	SN7400N	IC423	1
5322 209 84531	SN7420N	IC424	1
5322 209 84515	SN7414N	IC425	1
5322 209 84165	SN7474N	IC426	1
5322 209 84165	SN7474N	IC427	1

7,UNIT U5

7,1,MECHANICAL PARTS

Ordering code	Description	Item	Qty.
5322 255 40089	TRANSISTOR HOLDER	T018	4
5322 255 44055	IC HOLDER FOR 501-502-503		3
5322 267 54045	18-PIN CONNECTOR	BU503	1
5322 255 44025	IC HOLDER FOR IC519, IC520,521,522		4
5322 267 14011	MIN,COAX CONNECTOR	BU501 BU502	2

7,2,ELECTRICAL PARTS

RESISTORS,FIXED

Ordering code	Ω	%	Watt	Item	Qty.
4822 111 30312	4,7K	5	CR16	R501	1
5322 111 30288	47K	5	CR16	R502	1
5322 111 30366	75	5	CR16	R503	1
4822 111 30326	180	5	CR16	R504	1
5322 116 54503	267	1	MR25	R505	1
5322 111 30383	68	5	CR16	R506	1
4822 111 30331	470	5	CR16	R507	1
5322 111 30074	56	5	CR16	R509	1
4822 111 30328	330	5	CR16	R510	1
4822 111 30312	4,7K	5	CR16	R511	1
4822 111 30326	180	5	CR16	R512	1
4822 111 30329	390	5	CR16	R513	1
4822 111 30267	1,5K	5	CR16	R515	1
5322 111 34093	62	5	CR16	R516	1
5322 111 30383	68	5	CR16	R517	1
4822 111 30327	220	5	CR16	R518	1
4822 111 30352	82	5	CR16	R519	1
4822 111 30268	1,2K	5	CR16	R520	1
4822 111 30067	33	5	CR16	R521	1
4822 111 30309	560	5	CR16	R522	1
4822 111 30326	180	5	CR16	R524	1
4822 110 53085	150	5	CR37	R525	1
4822 111 30325	150	5	CR16	R526	1
4822 111 30269	1K	5	CR16	R527	1
4822 111 30324	100	5	CR16	R528	1
4822 111 30331	470	5	CR16	R529	1
4822 111 30331	470	5	CR16	R530	1
4822 111 30329	390	5	CR16	R531	1
4822 111 30327	220	5	CR16	R532	1
4822 111 30269	1K	5	CR16	R533	1

4822 111 30273	10K	5	CR16	R534	1
4822 111 30269	1K	5	CR16	R535	1
4822 111 30264	2,7K	5	CR16	R536	1
5322 111 30396	22	5	CR16	R537	1
4822 111 30328	330	5	CR16	R539	1
5322 111 30074	56	5	CR16	R540	1
4822 110 63125	4,7K		CR25	R541	1
4822 110 63134	10K	5	CR25	R542	1
4822 111 30327	220	5	CR16	R546	1
4822 111 30264	2K7	5	CR16	R547	1

RESISTORS,VARIABLE

Ordering code	Ω	%	Watt	Item	Qty.
5322 101 14049	470	20	0,5W	R508	1
5322 101 14051	220	20	0,5W	R514	1
5322 101 14051	220	20	0,5W	R523	1

CAPACITORS,FIXED

Ordering code	Farad	%	Volts	Item	Qty.
5322 122 34006	10N		40	C501	1
4822 122 30043	10N	-20+80	63	C502	1
4822 122 31165	330P	10	100	C503	1
4822 122 31067	33P	2	100	C504	1
4822 122 30043	10N	-20+80	63	C505	1
4822 122 31175	1N	10	100	C506	1
4822 122 31063	22P	2	100	C507	1
5322 124 14039	0,68M	-20+50	35	C508	1
4822 122 30114	2,2N	10	40	C509	1
5322 121 40323	0,1M	10	100	C510	1
5322 121 40323	0,1M	10	100	C511	1
4822 122 30043	10N	-20+80	63	C512	1
4822 124 20461	47M	-10+50	10	C513	1
5322 121 40323	0,1M	10	100	C514	1
5322 121 40323	0,1M	10	100	C515	1
5322 121 40323	0,1M	10	100	C516	1
4822 124 20461	47M	-10+50	10	C517	1
5322 121 40323	0,1M	10	100	C518	1
4822 122 30043	10N	-20+80	63	C519	1
4822 122 30043	10N	-20+80	63	C520	1
4822 122 30043	10N	-20+80	63	C521	1
4822 122 30027	1N	10	100	C522	1
4822 122 30114	2,2N	10	40	C523	1
4822 122 30043	10N	-20+80	63	C524	1
4822 122 30043	10N	-20+80	63	C525	1
5322 122 30132	100P		50	C526	1

INDUCTANCES

Ordering code	Description	Item	Qty.
5322 158 10052	CHOKE	L501	1
4822 526 10011	FXC BEAD	L502	1
4822 526 10025	FXC BEAD	L503	1
4822 526 10025	FXC BEAD	L504	1

DIODES

Ordering code	Type	Item	Qty.
5322 130 30644	BA182	GR501	1
5322 130 30613	BAW62	GR502	1
5322 130 30613	BAW62	GR503	1
5322 130 30613	BAW62	GR504	1
5322 130 30613	BAW62	GR505	1
5322 130 30613	BAW62	GR506	1
5322 130 30613	BAW62	GR507	1
5322 130 30613	BAW62	GR508	1
5322 130 30644	BA182	GR509	1
5322 130 30613	BAW62	GR510	1
5322 130 30644	BA182	GR511	1

TRANSISTORS

Ordering code	Type	Item	Qty
5322 130 40343	BC108B	TS502	1
5322 130 40745	BFW92	TS503	1
5322 130 40745	BFW92	TS504	1
5322 130 40348	BC178B	TS505	1
5322 130 40343	BC108B	TS506	1
4822 130 40937	BC548B	TS507	1

INTEGRATED CIRCUITS

Ordering code	Type	Item	Qty.
5322 216 64053	UM1/1 GATE	IC501	1
5322 209 84176	OM152 FLIP FLOP	IC502	1
5322 209 84039	OM110 RINGCOUNTER	IC503	1
5322 209 84726	IC-301CJ AMELCO	10504	1
5322 209 84431	MC10116L	IC505	1
5322 209 84645	MC10125L	IC506	1
5322 209 84178	SN7400N	IC507	1
5322 209 84227	SN7402N	IC508	1
5322 209 84341	SN74132N	IC509	1
5322 209 84651	SN74176N	IC510	1
5322 209 84168	SN74196N	IC511	1
5322 209 80072	SN7490N	IC512	1
5322 209 80072	SN7490N	IC513	1
5322 209 80072	SN7490N	IC514	1
5322 209 80072	SN7490N	IC515	1
5322 209 84651	SN74176N	IC516	1
5322 209 84651	SN74176N	IC517	1
5322 209 84651	SN74176N	IC518	1
5322 209 84652	RC8274MP	IC519	1
5322 209 84652	RC8274MP	IC520	1
5322 209 84652	RC8274MP	IC521	1
5322 209 84652	RC8274MP	IC522	1
5322 209 80077	SN7410N	IC523	1
5322 111 94015	CSP08C-S1 DALE	IC524	1
5322 111 94015	CSP08C-S1 DALE	IC525	1

8,UNIT U6

8,1,MECHANICAL PARTS

Ordering code	Description	Item	Qty
5322 462 34116	GUIDE RAIL		8
5322 256 34031	FUSE HOLDER		4
4822 253 20023	FUSE,2A,FAST	VL601-02	2
5322 255 40038	TRANSISTOR HOLDER	TO5	2
5322 267 60048	18-P CONNECTOR	BU613	1
5322 267 54009	10-P CONNECTOR	BU608	1
5322 267 54045	18-P CONNECTOR	BU610	1
5322 267 64005	22-P CONNECTOR	BU601	1
5322 267 64035	28-P CONNECTOR	BU602	1
5322 267 64035	28-P CONNECTOR	BU603	1
5322 267 64035	28-P CONNECTOR	BU604	1
5322 267 64035	28-P CONNECTOR	BU605	1
5322 265 54006	10-P CONNECTOR	BU609	1
4822 267 50202	15-P CONNECTOR	BU607	1
5322 264 54016	15-P CONNECTOR	BU612	1
5322 267 14011	MIN,COAX CONNECTOR BU615,BU616,BU617	BU614	4
5322 268 14029	FLAT CONNECTOR PINS		21
5322 255 44109	IC HOLDER, 24-PINS		1
5322 255 44025	IC HOLDER,16-PINS		2
5322 255 44082	IC HOLDER,14-PINS		4
5322 277 24003	SWITCH	SK601	1

8,2,ELECTRICAL PARTS

RESISTORS,FIXED

Ordering code	Ω	%	Watt	Item	Qty.
4822 110 63116	2,2K	5	CR25	R601	1
4822 110 63105	820	5	CR25	R602	1
4822 110 63105	820	5	CR25	R603	1
4822 110 63098	470	5	CR25	R604	1
4822 110 63129	6,8K	5	CR25	R605	1
4822 110 63107	1K	5	CR25	R606	1
4822 110 53101	560	5	CR37	R607	1
4822 110 63101	560	5	CR25	R608	1
4822 110 63107	100	5	CR25	R609	1
4822 110 63096	390	5	CR25	R610	1
4822 110 63129	6,8K	5	CR25	R611	1
4822 110 63143	22K	5	CR25	R612	1
4822 110 63101	560	5	CR25	R613	1
4822 110 63116	2,2K	5	CR25	R614	1
4822 110 63081	100	5	CR25	R615	1
4822 110 63107	1K	5	CR25	R616	1

CAPACITORS,FIXED

Ordering code	Farad	%	Volts	Item	Qty.
4822 124 20468	33M	-10+50	16	C602	1
5322 121 40323	0,1M	10	100	C603	1
4822 124 70238	6800M	-10+50	25	C605	1
4822 124 70238	6800M	-10+50	25	C606	1
4822 121 40232	0,22M	10	100	C607	1
4822 121 40232	0,22M	10	100	C608	1
5322 121 40323	0,1M	10	100	C609	1
5322 121 40323	0,1M	10	100	C610	1
5322 124 14033	10M		16	C611	1
4822 124 20586	150M		16	C613	1
4822 124 20586	150M	-10+50	16	C614	1
5322 121 50502	15N	1	63	C615	1
4822 121 40207	0,33M	10	250	C616	1
5322 121 40323	0,1M	10	100	C617	1

CAPACITORS,VARIABLE

Ordering code	Farad	%	Volts	Item	Qty.
5322 125 50057	5,5-65P		100	C604	1

INDUCTANCES

Ordering code	Description	Item	Qty.
5322 158 14004	INDUCTANCE 15 UH	L601	1
5322 158 14052	INDUCTANCE 1 MH	L602	1
5322 158 10278	INDUCTANCE 1 MH	L603	1
5322 158 10052	CHOKE	L604	1
5322 158 10052	CHOKE	L605	1
5322 158 44052	TRANSFORMER	T601	1
5322 158 10052	CHOKE	L607	1
5322 158 10052	CHOKE	L608	1

DIODES

Ordering code	Type	Item	Qty.
5322 130 30613	BAW62	GR601	1
5322 130 30613	BAW62	GR602	1
5322 130 30613	BAW62	GR603	1
5322 130 30613	BAW62	GR604	1
5322 130 30613	BAW62	GR605	1
5322 130 34366	BYX70-500	GR606	1
5322 130 34366	BYX70-500	GR607	1
5322 130 34366	BYX70-500	GR608	1
5322 130 34366	BYX70-500	GR609	1

TRANSISTORS

Ordering code	Type	Item	Qty.
5322 130 40714	BSW67	TS601	1
5322 130 40714	BSW67	TS602	1

INTEGRATED CIRCUITS

Ordering code	Type	Item	Qty.
5322 209 84296	SN74157N	IC601	1
5322 209 84296	SN74157N	IC602	1
5322 209 84653	ROM	IC603	1
5322 209 84178	SN7400N	IC604	1
5322 209 80077	SN7410N	IC605	1
5322 111 94015	CSP08C-S1 DALE	IC606	1
5322 111 94015	CSP08C-S1 DALE	IC607	1
5322 209 84304	SN75107AN	IC608	1
5322 209 84178	SN7400N	IC609	1
5322 111 94015	CSP08C-S1 DALE	IC610	1
5322 111 94015	CSP08C-S1 DALE	IC611	1
5322 111 94015	CSP08C-S1 DALE	IC612	1

CRYSTAL OSCILLATOR

Ordering code	Type	Item	Qty.
5322 216 94047	TCXO		1

9.UNIT U7

9.1.MECHANICAL PARTS

Ordering code	Description	Item	Qty.
5322 264 54016	15-P CONNECTOR,MALE		1
5322 264 54016	17-P CONNECTOR,MALE		1
5322 267 10004	BNC CONNECTOR	BU704	1
5322 267 10004	BNC CONNECTOR	BU705	1
5322 268 24049	FEMALE CONNECTOR		4
5322 268 44057	HOLDER FOR DIO		1
5322 280 20007	REED CONTACT	RE701	1
5322 280 24065	REED RELAY RE703,RE705,RE706	RE702	4
5322 280 24062	REED RELAY	RE704 RE707	2
5322 255 40089	TRANSISTOR HOLDER	TO18	3

9.2.ELECTRICAL PARTS

RESISTORS,FIXED

Ordering code	Ω	%	Watt	Item	Qty.
4822 111 30331	470	5	CR16	R701	1
5322 116 54262	51	5	PR52	R702	1
4822 111 30331	470	5	CR16	R703	1
5322 116 54408	909K	1	MR30	R704	1
5322 116 54696	100K	1	MR25	R705	1
4822 110 63178	470K	5	CR25	R706	1
5322 111 30074	56	5	CR16	R707	1
4822 111 30326	180	5	CR16	R708	1
4822 111 30327	220	5	CR16	R709	1
4822 111 30327	220	5	CR16	R710	1
5322 116 54568	1,82K	1	MR25	R711	1
5322 116 54574	2,21K	1	MR25	R712	1
5322 116 54929	56	5	PR37	R713	1
5322 111 30074	56	5	CR16	R714	1
5322 116 50519	43,2	1	MR25	R715	1
5322 116 50519	43,2	1	MR25	R716	1
5322 116 54574	2,21K	1	MR25	R717	1
5322 116 54568	1,82K	1	MR25	R718	1
5322 116 54619	10K	1	MR25	R720	1
5322 116 54564	1,5K	1	MR25	R721	1
5322 116 54446	56,2	1	MR25	R722	1
4822 110 63178	470K	5	CR25	R723	1
4822 110 63161	100K	5	CR25	R724	1
5322 116 54005	3,32K	1	MR25	R725	1
5322 116 54011	5,62K	1	MR25	R726	1
5322 116 54011	5,62K	1	MR25	R727	1
5322 116 54005	3,32K	1	MR25	R728	1
4822 111 30331	470	5	CR16	R729	1
5322 116 54262	51	5	PR52	R730	1
4822 111 30331	470	5	CR16	R731	1
5322 116 54408	909K	1	MR30	R732	1
5322 116 54696	100K	1	MR25	R733	1
4822 110 63178	470K	5	CR25	R734	1
5322 111 30074	56	5	CR16	R735	1
4822 111 30326	180	5	CR16	R736	1
4822 111 30327	220	5	CR16	R737	1
4822 111 30327	220	5	CR16	R738	1
5322 116 54568	1,82K	1	MR25	R739	1
5322 116 54574	2,21K	1	MR25	R740	1
5322 116 54929	56	5	PR37	R741	1
5322 111 30074	56	5	CR16	R742	1
5322 116 50519	43,2	1	MR25	R743	1
5322 116 50519	43,2	1	MR25	R744	1
5322 116 54574	2,21K	1	MR25	R745	1
5322 116 54568	1,82K	1	MR25	R746	1
5322 116 54619	10K	1	MR25	R748	1
5322 116 54564	1,5K	1	MR25	R749	1
5322 116 54446	56,2	1	MR25	R750	1
4822 110 63178	470K	5	CR25	R751	1
4822 110 63161	100K	5	CR25	R752	1
5322 116 54011	5,62K	1	MR25	R753	1
5322 116 54005	3,32K	1	MR25	R754	1
5322 116 54005	3,32K	1	MR25	R755	1
5322 116 54011	5,62K	1	MR25	R756	1
4822 110 63134	10K	5	CR25	R757	1
5322 116 54652	26,7K	1	MR25	R758	1
5322 116 54696	100K	1	MR25	R759	1
4822 110 63107	1K	5	CR25	R760	1

5322 116 54578	2,67K	1	MR25	R762	1
5322 116 54578	2,67K	1	MR25	R763	1
5322 116 54529	619	1	MR25	R764	1
5322 116 54529	619	1	MR25	R765	1
5322 116 54529	619	1	MR25	R766	1
5322 116 54529	619	1	MR25	R767	1
5322 116 50747	1K	1	MR25	R768	1
4822 111 30348	27	5	CR16	R774	1
4822 111 30348	27	5	CR16	R775	1
4822 111 30348	27	5	CR16	R776	1
4822 111 30348	27	5	CR16	R777	1
5322 116 50747	1K	1	MR25	R769	1
4822 111 30348	27	5	CR16	R770	1
4822 111 30245	47	5	CR16	R771	1
4822 111 30348	27	5	CR16	R772	1
4822 111 30245	47	5	CR16	R773	1
4822 111 30328	330	5	CR16	R780	1
4822 111 30328	330	5	CR16	R781	1

RESISTORS,VARIABLE

Ordering code	Ω	%	Watt	Item	Qty.
5322 100 10112	1K	20	0,5W	R719	1
5322 100 10112	1K	20	0,5W	R747	1

CAPACITORS,FIXED

Ordering code	Farad	%	Volts	Item	Qty.
5322 122 34044	3K3	10	500	C701	1
5322 122 34038	33P	10	50	C703	1
5322 122 34045	330P	10	500	C704	1
4822 122 30043	10N	-20+80	63	C705	1
4822 122 30043	10N	-20+80	63	C706	1
4822 122 31175	1N	10	100	C707	1
4822 122 31175	1N	10	100	C708	1
4822 122 31058	15	2	100	C709	1
4822 122 30043	10N	-20+80	63	C710	1
5322 122 34044	3K3	10	500	C711	1
5322 122 34038	33P	10	50	C713	1
5322 122 34045	330P	10	500	C714	1
4822 122 30043	10N	-20+80	63	C716	1
4822 122 30043	10N	-20+80	63	C717	1
4822 122 31175	1N	10	100	C718	1
4822 122 31175	1N	10	100	C719	1
4822 122 31058	15	2	100	C720	1
4822 122 30043	10N	-20+80	63	C721	1
4822 122 31175	1N	10	100	C722	1
4822 122 30043	10N	-20+80	63	C723	1
4822 122 31175	1N	10	100	C725	1
4822 122 30043	10N	-20+80	63	C726	1

CAPACITORS,VARIABLE

Ordering code	Farad	%	Volts	Item	Qty.
5322 125 50049	1,8-10P		300	C702	1
5322 125 50049	1,8-10P		300	C712	1

INDUCTANCES

Ordering code	Description	Item	Qty.
5322 281 60125	RELAY COIL FOR RE701		1
4822 526 10025	FXC BEAD	L701-707	7
4822 526 10097	FXC BEAD	L708,709	2

DIODES

Ordering code	Type	Item	Qty.
5322 130 34045	FD777	GR701	1
5322 130 34045	FD777	GR702	1
5322 130 34045	FD777	GR703	1
5322 130 34045	FD777	GR704	1
5322 130 30613	BAW62	GR705	1
5322 130 30613	BAW62	GR706	1
5322 130 30613	BAW62	GR707	1
5322 130 40182	BAX13	GR708	1
5322 130 30613	BAW62	GR709	1
5322 130 30613	BAW62	GR710	1
5322 130 30613	BAW62	GR711	1
5322 130 30613	BAW62	GR712	1
5322 130 30613	BAW62	GR713	1
5322 130 34119	BZX79-C8V2	GR714	1
5322 130 30613	BAW62	GR715	1
5322 130 30765	BZX75-C3V6	GR716	1

TRANSISTORS

Ordering code	Type	Item	Qty.
5322 130 44383	E421 SELECTED	TS701	1
5322 130 40745	BFW92	TS702	1
5322 130 40745	BFW92	TS703	1
5322 130 40745	BFW92	TS704	1
5322 130 40745	BFW92	TS705	1
5322 130 40144	BC109C	TS706	1
5322 130 44383	E421 SELECTED	TS707	1
5322 130 40745	BFW92	TS708	1
5322 130 40745	BFW92	TS709	1
5322 130 40745	BFW92	TS710	1
5322 130 40745	BFW92	TS711	1
5322 130 40144	BC109C	TS712	1
4822 130 40855	BC337	TS713	1

INTEGRATED CIRCUITS

Ordering code	Type	Item	Qty.
5322 209 84654	SCL4416AE	IC701	1

10,UNIT U8

10,1MECHANICAL PARTS

Ordering code	Description	Item	Qty.
5322 255 40089	TRANSISTOR HOLDER	TO18-4	2
5322 255 40038	TRANSISTOR HOLDER	TO5-3	2
5322 255 40089	TRANSISTOR HOLDER	TO18-3	5

10-2ELECTRICAL PARTS

RESISTORS,FIXED

Ordering code	Ω	%	Watt	Item	Qty.
4822 110 63107	1K	5	CR25	R803	1
4822 110 63107	1K	5	CR25	R804	1
5322 116 50747	1K	1	MR25	R805	1
5322 116 54005	3,32K	1	MR25	R806	1
4822 110 63107	1K	5	CR25	R807	1
4822 110 63085	150	5	CR25	R808	1
4822 110 63072	47	5	CR25	R809	1
4822 110 63125	4,7K	5	CR25	R810	1
4822 110 63076	68	5	CR25	R811	1
4822 110 63098	470	5	CR25	R812	1
4822 110 63125	4,7K	5	CR25	R813	1
4822 110 63125	4,7K	5	CR25	R814	1
4822 110 63089	220	5	CR25	R815	1
5322 113 60015	0,22	10	4W	R816	1
4822 110 63107	1K	5	CR25	R817	1
4822 110 63098	470	5	CR25	R818	1
4822 110 63134	10K	5	CR25	R819	1
4822 110 63081	100	5	CR25	R820	1
4822 110 63081	100	5	CR25	R821	1
5322 116 54536	750	1	MR25	R822	1
5322 116 54005	3,32K	1	MR25	R823	1
4822 110 63094	330	5	CR25	R824	1
4822 110 63134	10K	5	CR25	R825	1
4822 110 63107	1K	5	CR25	R826	1
4822 110 63076	68	5	CR25	R827	1
4822 110 63089	220	5	CR25	R828	1
4822 110 63125	4,7K	5	CR25	R829	1
4822 110 63089	220	5	CR25	R830	1
	0,33	10	4W	R831	1
4822 110 63125	4,7K	5	CR25	R832	1
4822 110 63098	470	5	CR25	R833	1
4822 110 63134	10K	5	CR25	R834	1
4822 110 63081	100	5	CR25	R835	1
4822 110 63081	100	5	CR25	R836	1
4822 110 63152	47K	5	CR25	R837	1
4822 110 63152	47K	5	CR25	R838	1
4822 110 63169	220K	5	CR25	R839	1
4822 110 63169	220K	5	CR25	R840	1
5322 116 50526	1,3K	1	MR25	R841	1

RESISTORS,VARIABLE

Ordering code	Ω	%	Watt	Item	Qty.
5322 101 14049	470	20	0,5W	R801	1
5322 101 14049	470	20	0,5W	R802	1

CAPACITORS,FIXED

Ordering code	Farad	%	Volts	Item	Qty.
5322 121 50502	15N	1	63	C801	1
5322 121 40323	100N	10	100	C802	1
5322 121 44002	10N	10	250	C803	1
5322 121 44002	10N	10	250	C804	1
5322 121 40323	100N	10	100	C805	1
5322 121 40323	100N	10	100	C806	1
4822 124 20461	47M	-10+50	10	C807	1
4822 124 20589	220M	-10+50	10	C808	1
4822 124 20461	47M	-10+50	10	C809	1
4822 124 20589	220M	-10+50	10	C810	1
4822 122 31081	100P	2	100	C811	1
4822 122 31081	100P	2	100	C812	1
4822 122 30128	4,7N	10	100	C813	1
4822 122 30128	4,7N	10	100	C814	1
4822 122 30114	2,2N	10	100	C815	1
4822 122 30114	2,2N	10	100	C816	1
4822 122 30043	10N	-20+80	63	C817	1
4822 122 30043	10N	-20+80	63	C818	1
4822 122 31081	100P	2	100	C819	1
4822 124 20476	22M		25	C820	1
4822 124 20476	22M		25	C821	1

INDUCTANCES

Ordering code	Description	Item	Qty.
5322 158 14096	INDUCTANCE 3 MH	L801	1
5322 158 14096	INDUCTANCE 3 MH	L802	1
4822 526 10097	FXC BEAD	L803	1
4822 526 10097	FXC BEAD	L804	1
4822 526 10011	FXC BEAD	L805	1
4822 526 10011	FXC BEAD	L806	1
4822 526 10011	FXC BEAD	L807	1
4822 526 10011	FXC BEAD	L808	1
4822 526 10097	FXC BEAD	L809-812	4

DIODES

Ordering code	Type	Item	Qty.
5322 130 30613	BAW62	GR801	1
5322 130 30759	BZX79-C6V2	GR802	1
4822 130 30865	BYX71-350	GR803	1
5322 130 30759	BZX79-C5V6	GR804	1
5322 130 20031	BT100A-300R THYR,	GR805	1
5322 130 30759	BZX79-C6V2	GR806	1
5322 130 20031	BT100A-300R THYR,	GR807	1
4822 130 30865	BYX71-350	GR808	1
5322 130 30613	BAW62	GR809	1

TRANSISTORS

Ordering code	Type	Item	Qty.
5322 130 40021	2N2905	TS801	1
5322 130 40752	BD131	TS802	1
4822 130 40522	BC177	TS803	1
5322 130 40332	BC107B	TS804	1
4822 130 40522	BC177	TS805	1
5322 130 40294	BFY50	TS806	1
5322 130 40752	BD131	TS807	1
5322 130 40332	BC107B	TS808	1
4822 130 40522	BC177	TS809	1
5322 130 40482	BRY39	TS810	1
5322 130 40482	BRY39	TS811	1

INTEGRATED CIRCUITS

Ordering code	Type	Item	Qty.
		IC801	1
5322 209 84655	723 PC	IC802	1
5322 209 84655	723 PC	IC803	1

11,UNIT U-9

11,1, MECH, PARTS

Ordering code	Description	Item	Qty.
5322 264 54017	10-P MALE CONNECTOR		1
5322 255 40089	TRANSISTOR HOLDER	TO18	2

11,2, ELECTR, PARTS

RESISTORS,FIXED

Ordering code	Ω	%	Watt	Item	Qty.
4822 110 63098	470	5	CR25	R901	1
4822 110 63107	1K	5	CR25	R902	1
4822 110 63098	470	5	CR25	R903	1
4822 110 63112	1,5	5	CR25	R904	1
4822 110 63081	100	5	CR25	R905	1
4822 113 60026	0,82		4W	R906	1
4822 110 63103	680	5	CR25	R907	1
5322 116 54011	5,62K	1	MR25	R908	1
5322 116 54591	3,92K	1	MR25	R910	1
4822 110 63105	820	5	CR25	R911	1
4822 110 63098	470	5	CR25	R912	1
5322 113 60092	0,82		4W	R913	1
5322 116 54615	9,09K	1	MR25	R914	1
5322 116 54545	909	1	MR25	R915	1
5322 116 54619	10K	1	MR25	R916	1

RESISTORS,VARIABLE

Ordering code	Ω	%	Watt	Item	Qty.
5322 100 10115	1K	20	0,5W	R909	1

CAPACITORS,FIXED

Ordering code	Farad	%	Volts	Item	Qty.
4822 124 20476	22M	-10+50	25	C901	1
4822 124 20476	22M	-10+50	25	C902	1
4822 124 20461	47M	-10+50	10	C903	1
4822 124 20476	22M	-10+50	25	C904	1
4822 124 20476	22M	-10+50	25	C905	1
4822 122 30043	10N	-20+80	63	C906	1

DIODES

Ordering code	Type	Item	Qty.
5322 130 30766	BZX79-C6V2	GR901	1
5322 130 30767	BZX79-C5V1	GR902	1
5322 130 30767	BZX79-C5V1	GR903	1
5322 130 30192	BY126	GR904	1
5322 130 30767	BZX79-C5V1	GR905	1
5322 130 30192	BY126	GR906	1
5322 130 34046	BZX79-C11	GR907	1
5322 130 30613	BAW62	GR908	1

TRANSISTORS

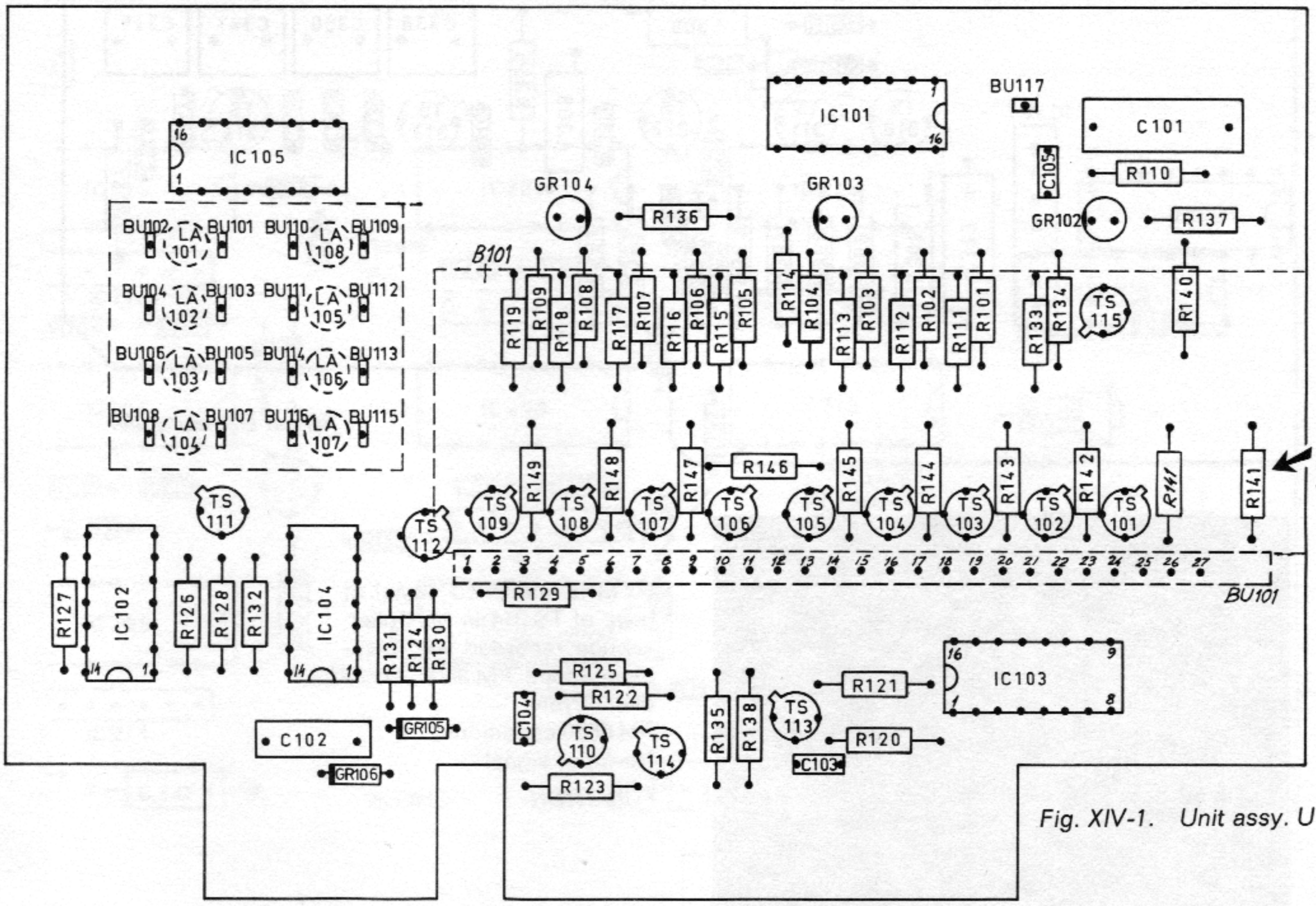
Ordering code	Type	Item	Qty.
	BD267	TS901	1
5322 130 40332	BC107B	TS902	1
	BD266	TS903	1
5322 130 40348	BC178B	TS904	1

INTEGRATED CIRCUITS

Ordering code	Type	Item	Qty.
5322 209 84163	SN72741P	IC901	1
5322 209 84163	SN72741P	IC902	1

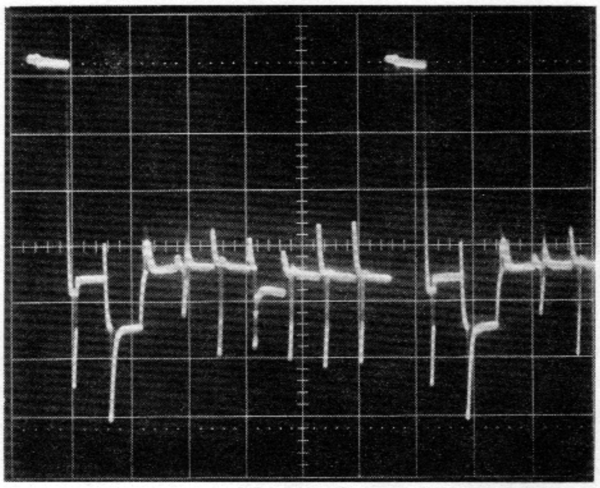
COMPLETE UNITS

Ordering code	Description	Item	Qty.
5322 216 64139	UNIT U1 EXCEPT INDICATOR UNIT,DISPLAY, DISPLAY HOLDER,LED'S TRANSISTORS ON SOCKETS	U1	1
5322 216 64141	UNIT U2,COMPLETE	U2	1
5322 216 64142	UNIT U3,COMPLETE	U3	1
5322 216 64143	UNIT U4,COMPLETE	U4	1
5322 216 64144	UNIT U5,COMPLETE	U5	1
5322 216 64145	UNIT U7,COMPLETE	U7	1
5322 216 64146	UNIT U8,COMPLETE	U8	1
5322 216 64147	UNIT U9,COMPLETE	U9	1



R141 placed here from series -/03

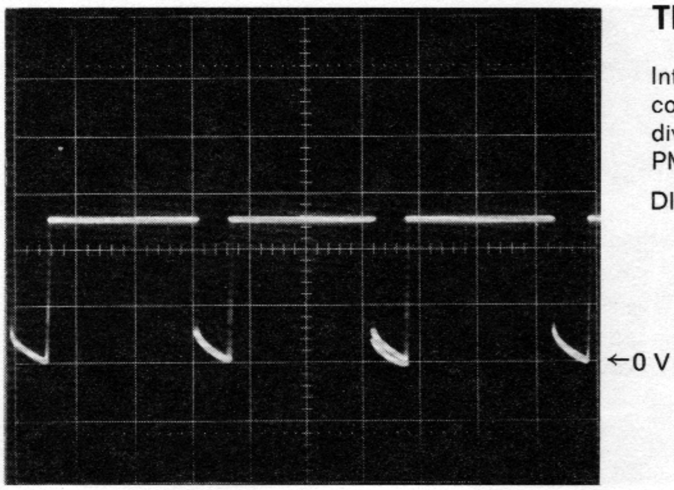
Fig. XIV-1. *Unit assy. U1*



TP1

Display anode signal at B 101 :6. 0.5 ms/div, 10 V/div.
PM 6650 settings:

DISPLAY TIME:	"HOLD"
MEMORY:	depressed
TIME BASE:	100 ms
FUNCTION:	CHECK



TP2

Inter-digit blanking signal at collector of TS 113. 0.1 ms/div, 2 V/div.
PM 6650 settings:

DISPLAY TIME: "HOLD"

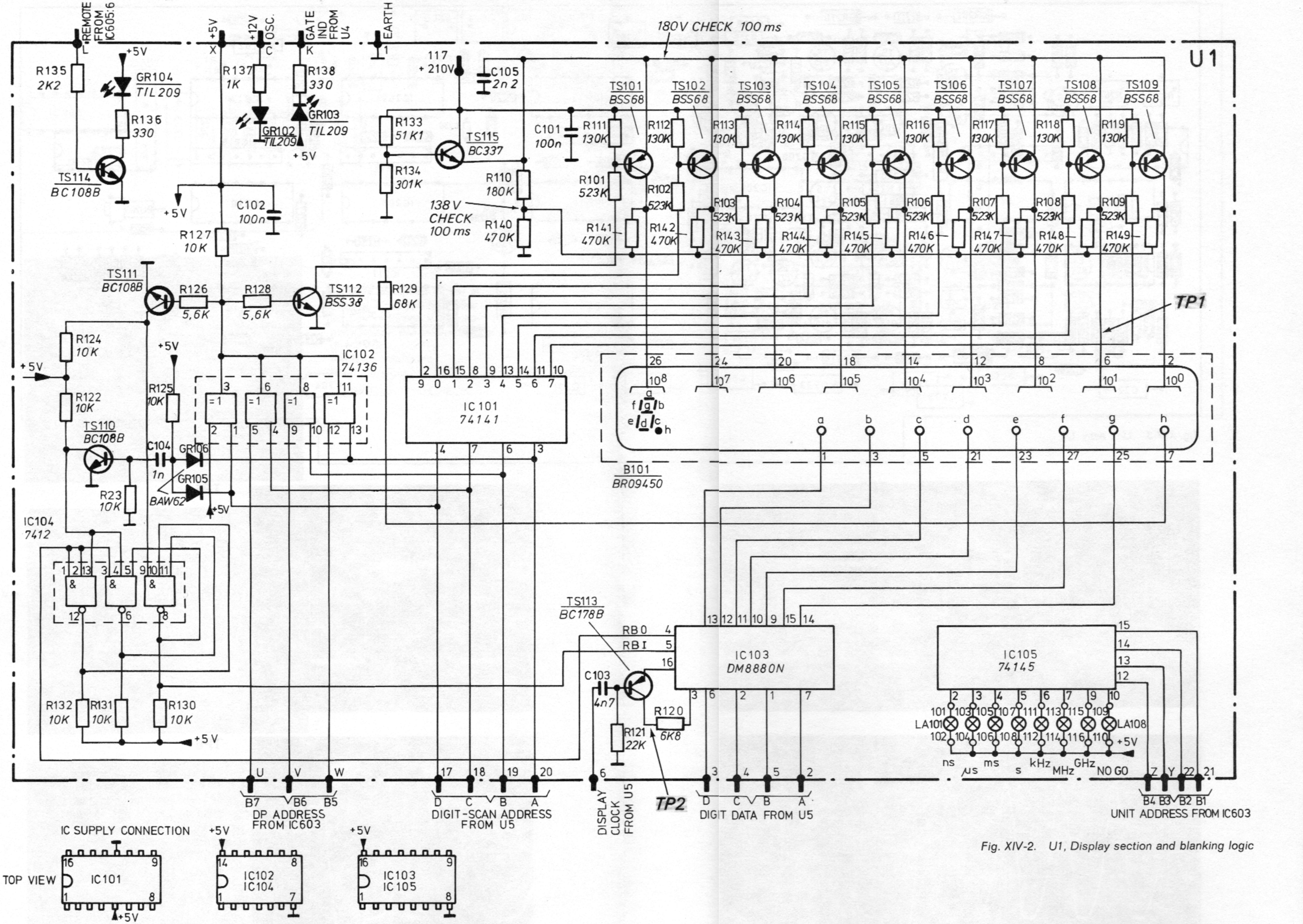


Fig. XIV-2. U1, Display section and blanking logic

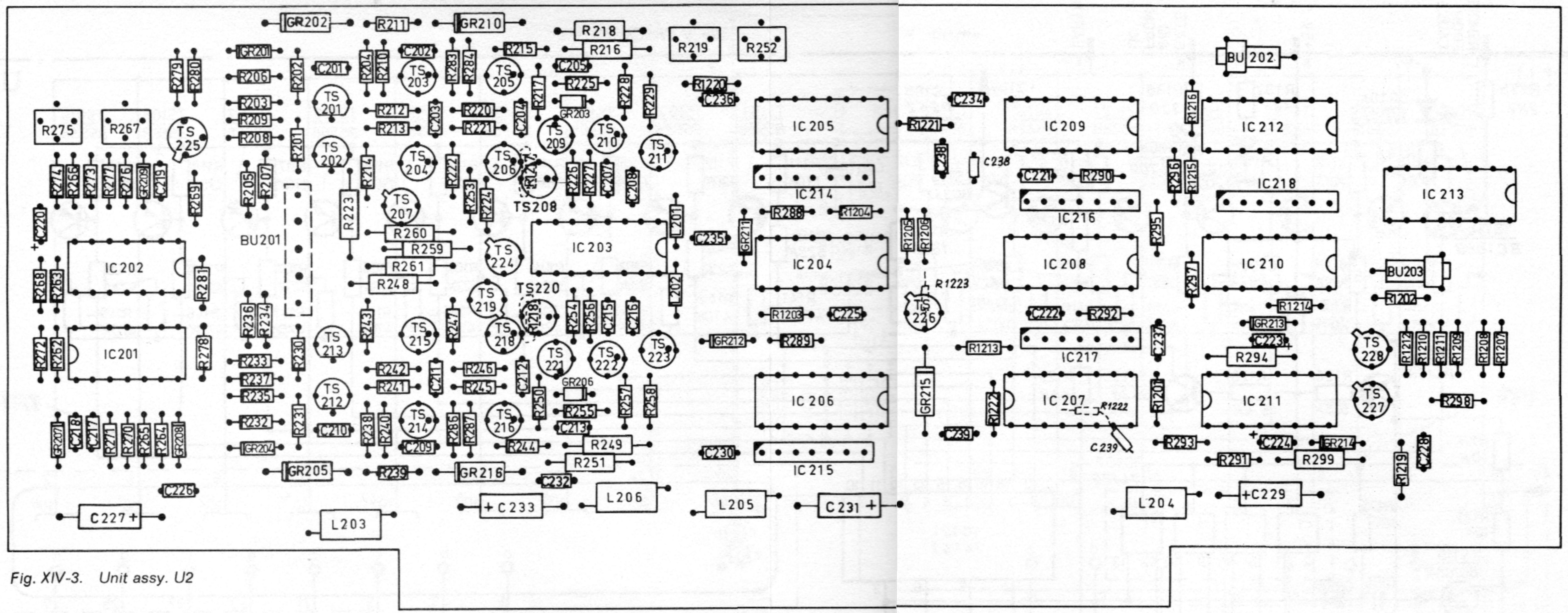
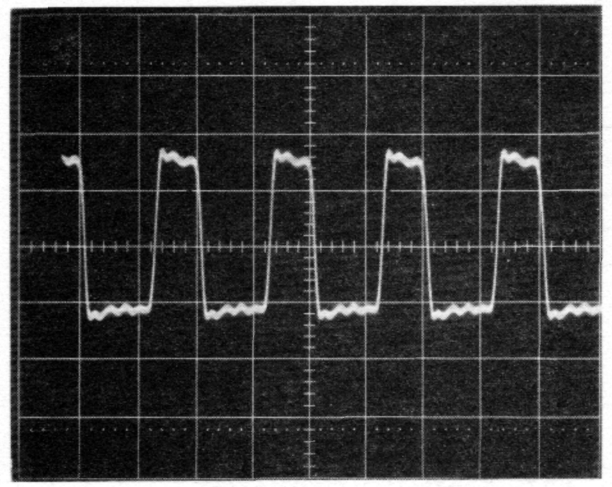


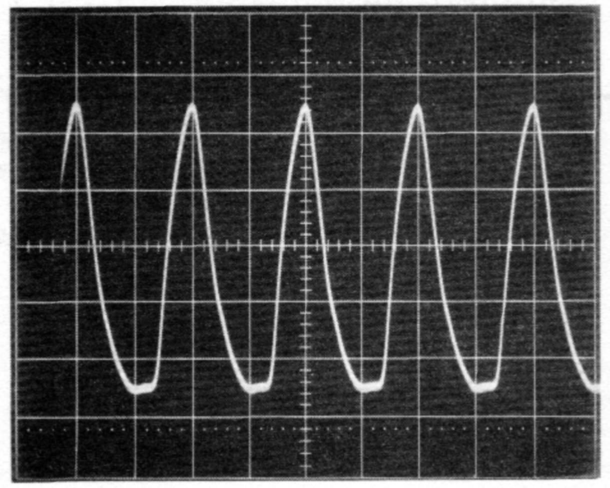
Fig. XIV-3. Unit assy. U2



TP3

Channel A amplifier output signal at emitter of TS 211. 0.05 μs/div, 0.5 V/div.
PM 6650 conditions:
10 MHz OUT (rear) applied to input A

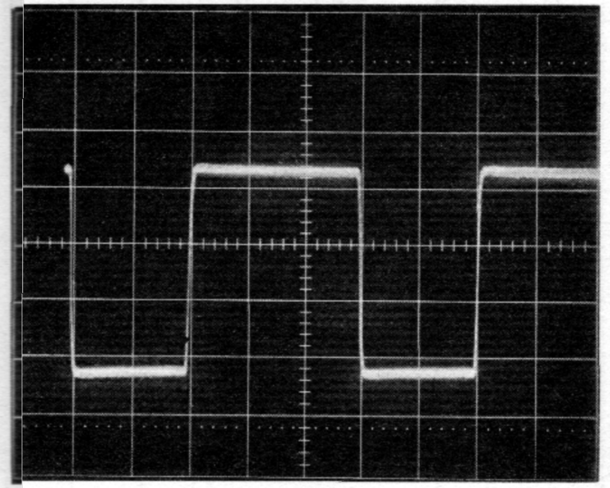
FUNCTION:	FREQ A
COUPL:	AC
1 MΩ/(50 Ω):	50 Ω
LEVEL:	PRESET



TP4

"Number of averagings" at collector of TS 226. 0.05 μs/div, 1 V/div.
PM 6650 conditions:
10 MHz OUT (rear) applied to input B

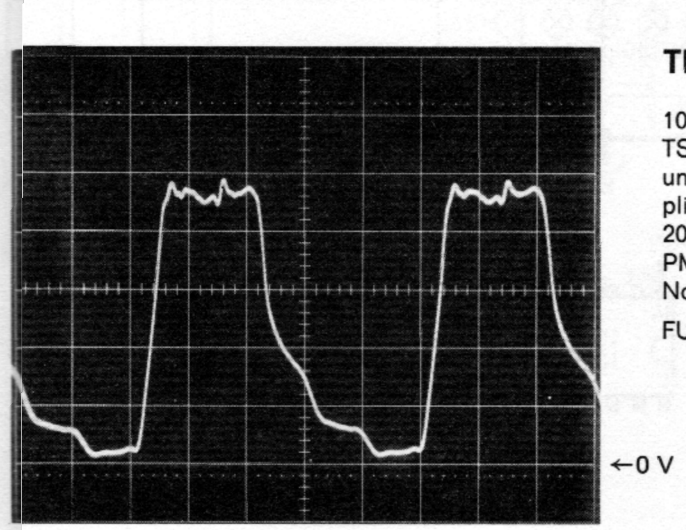
FUNCTION:	T.I. AVG. A TO B
COUPL:	AC
1 MΩ/50 Ω:	50 Ω
LEVEL:	PRESET



TP5

Time Base Out signal at socket BU 203. 0.2 μs/div, 0.5 V/div.
PM 6650 conditions:
No input signal

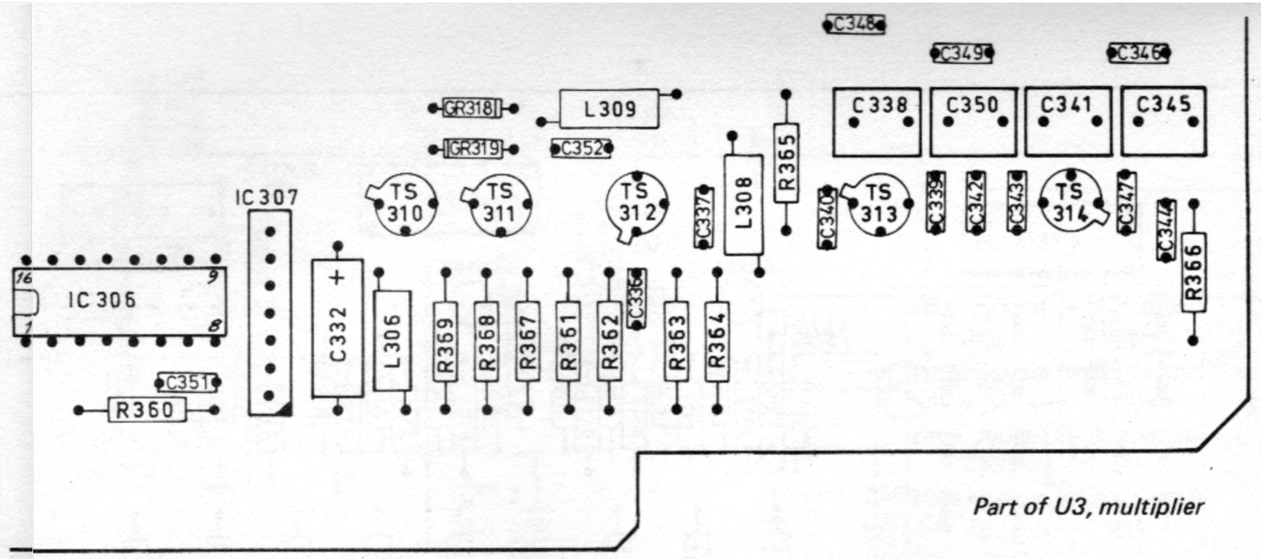
FUNCTION:	PERIOD A
TIME BASE:	1 μs



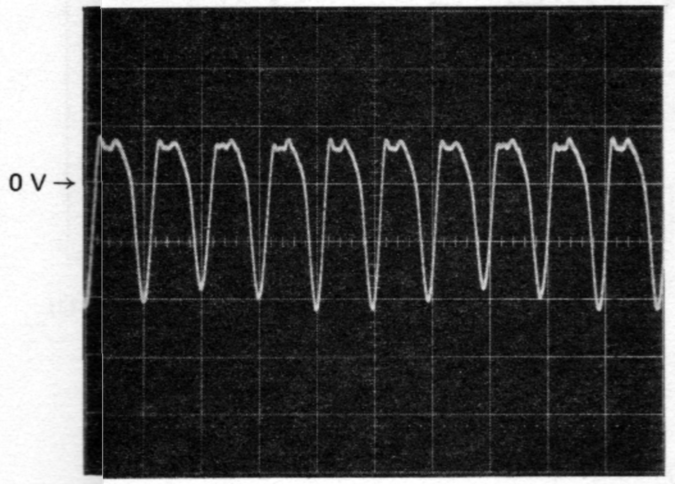
TP6

10 MHz signal at collector of TS 312 in Multiplier section, unit U3, recorded with sampling scope PM 3400, 1 V/div, 20 ns/div.
PM 6650 conditions:
No input signal

FUNCTION:	CHECK



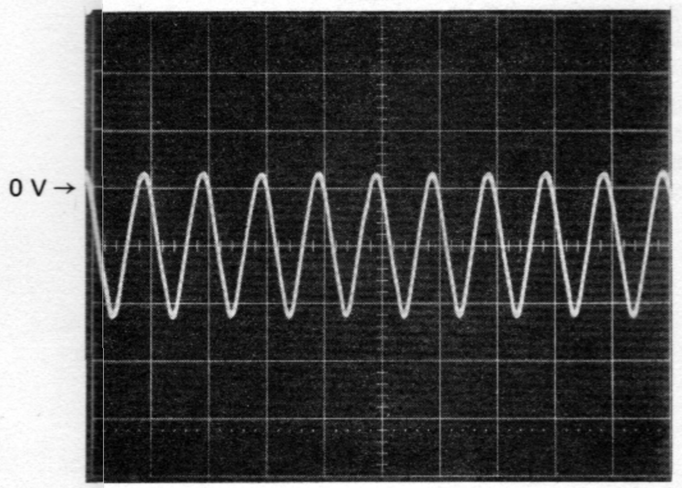
Part of U3, multiplier



TP7

50 MHz multiplied signal at base of TS 314 in Multiplier section recorded with sampling scope PM 3400, 20 ns/div, 1 V/div.
PM 6650 conditions:
No input signal

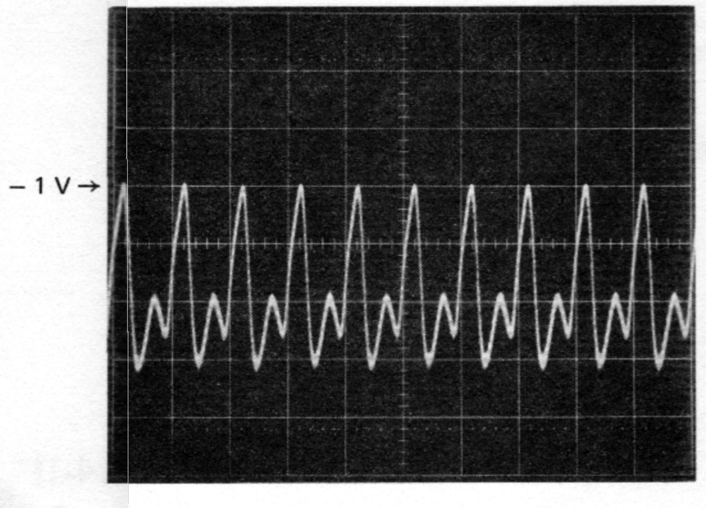
FUNCTION:	CHECK



TP8

100 MHz multiplied signal at IC 306:13 in Multiplier section recorded with sampling scope PM 3400, 10 ns/div, 1 V/div.
PM 6650 conditions:
No input signal

FUNCTION:	CHECK



TP9

100 MHz Multiplier output at IC 306:2 recorded with PM 3400 sampling scope and coupling capacitor, 10 ns/div, 200 mV/div. Distortion is caused by reflections in extender test board.
PM 6650 conditions:

FUNCTION:	CHECK

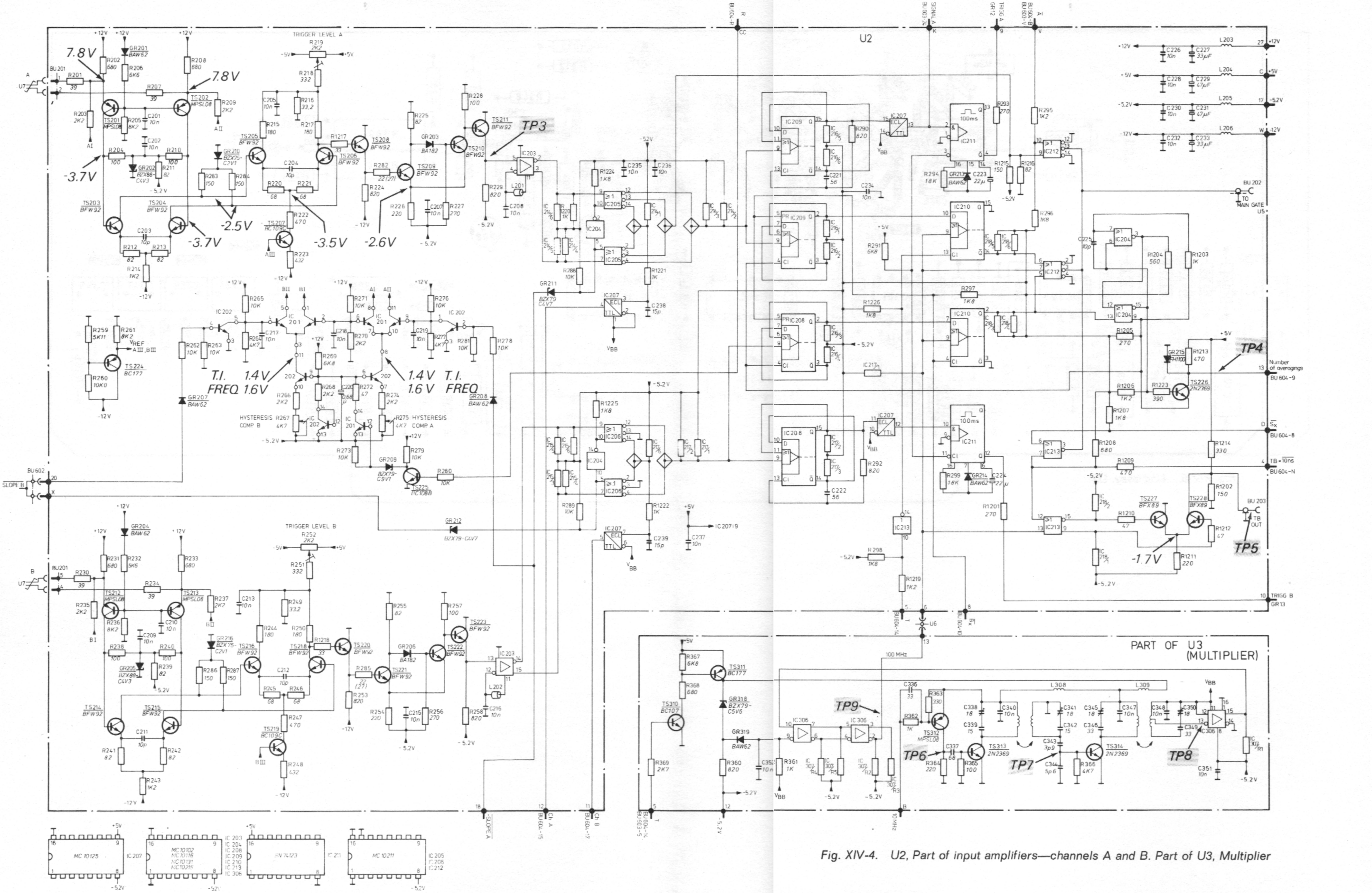


Fig. XIV-4. U2, Part of input amplifiers—channels A and B. Part of U3, Multiplier

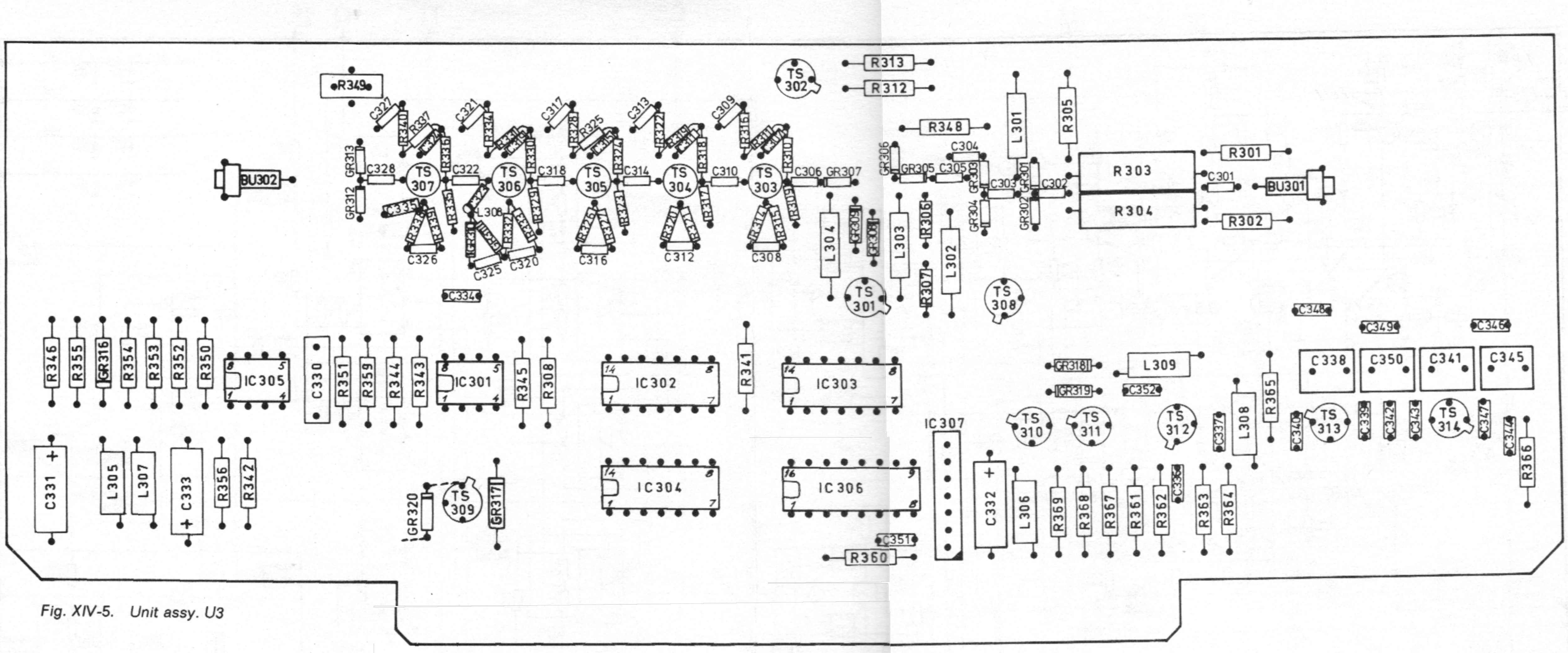
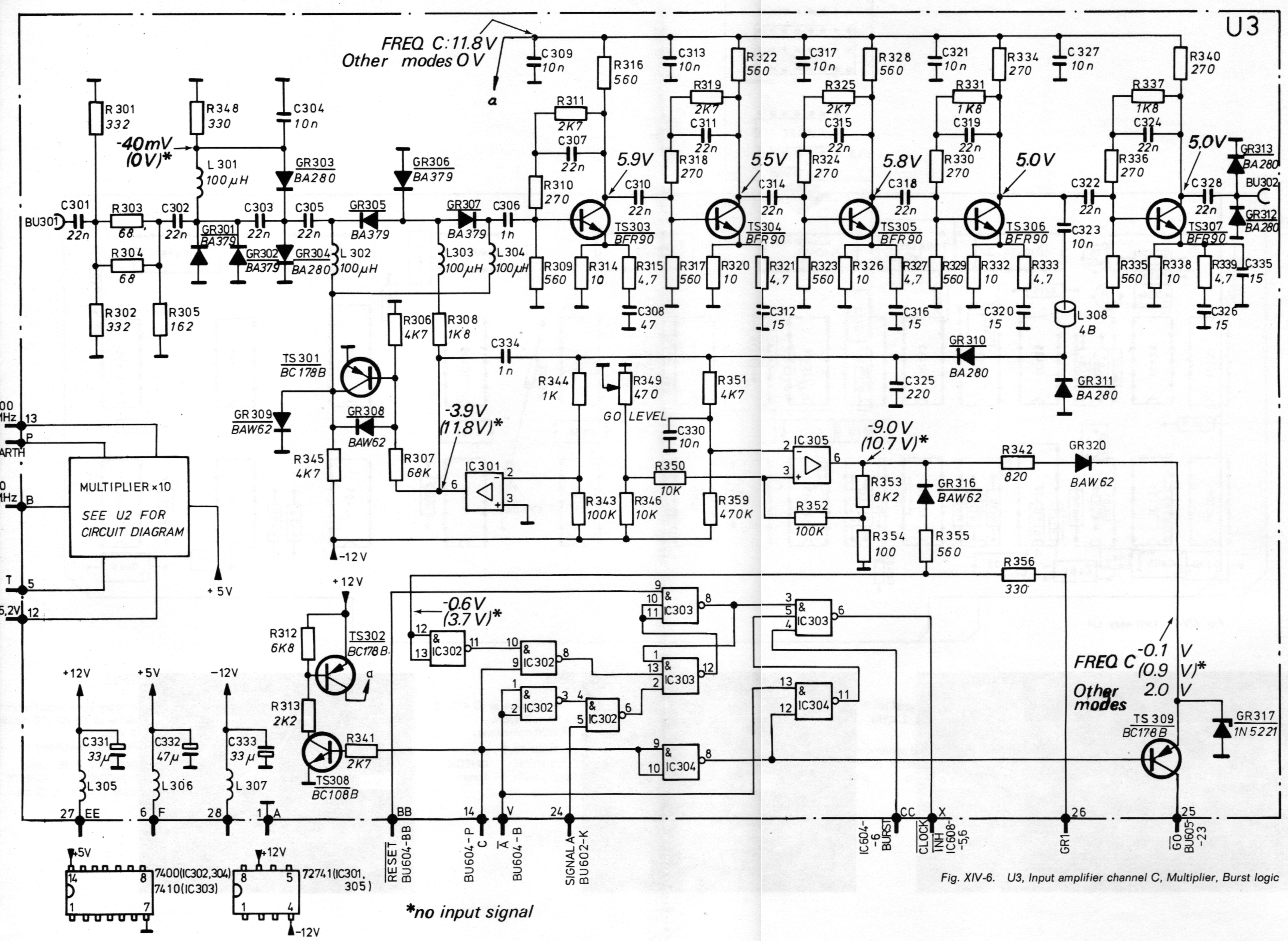


Fig. XIV-5. Unit assy. U3



*no input signal

Fig. XIV-6. U3, Input amplifier channel C, Multiplier, Burst logic

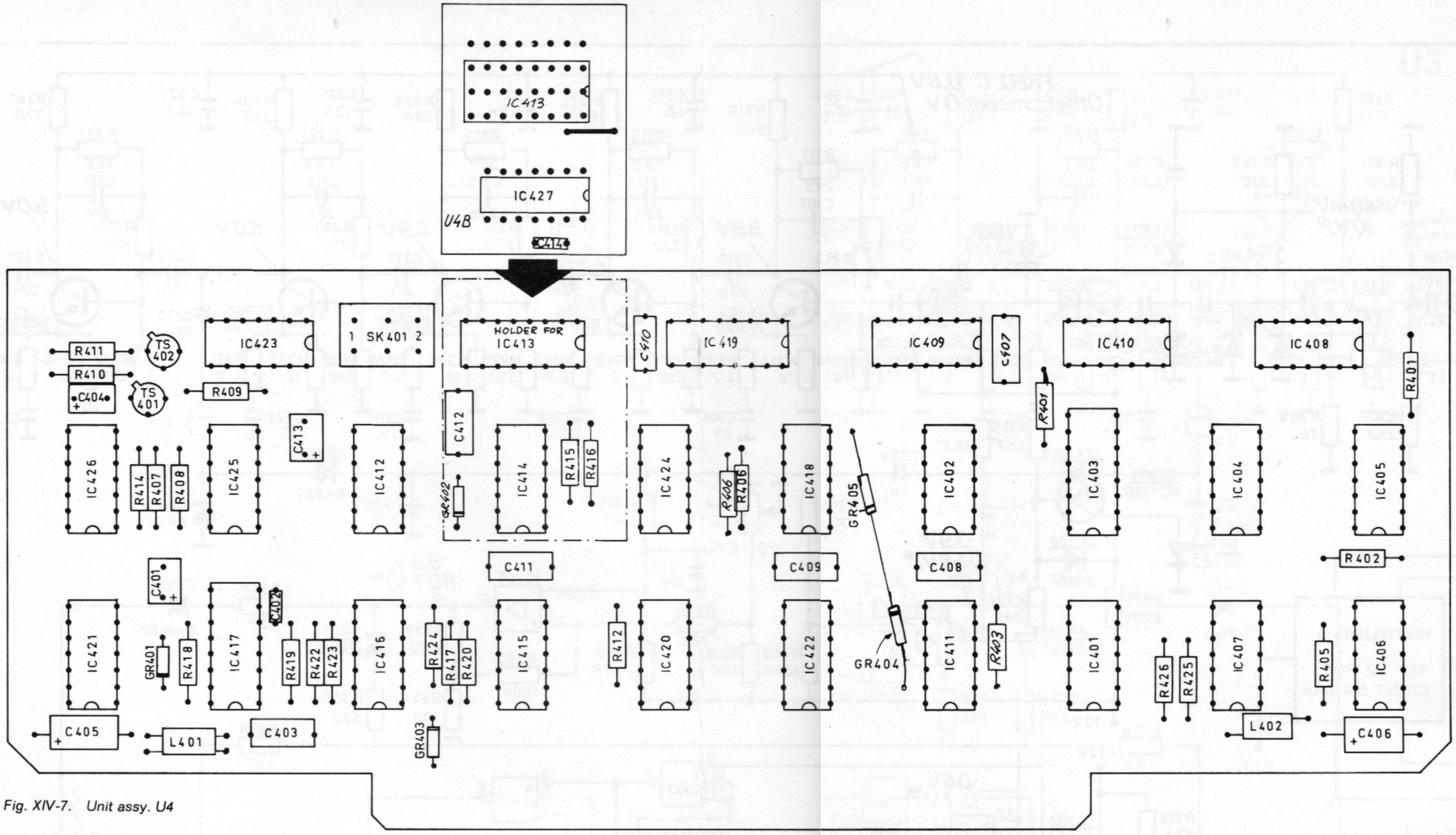
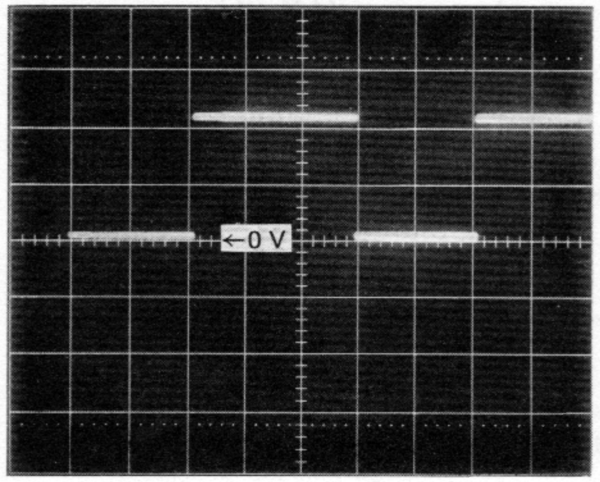


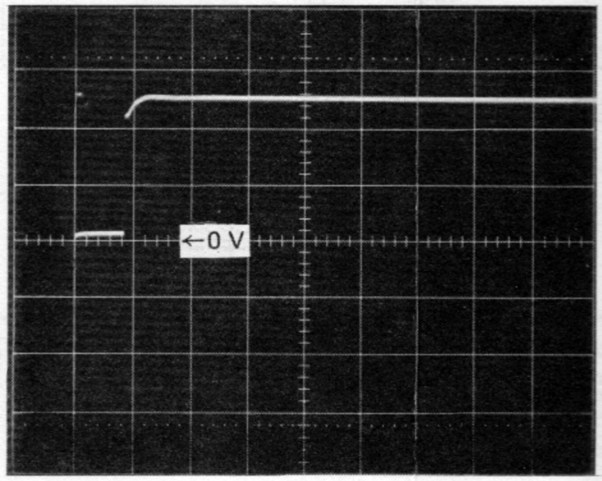
Fig. XIV-7. Unit assy. U4



TP10

"GATE" indicator signal at IC 417:4. 50 ms/div, 2 V/div. PM 6650 conditions:

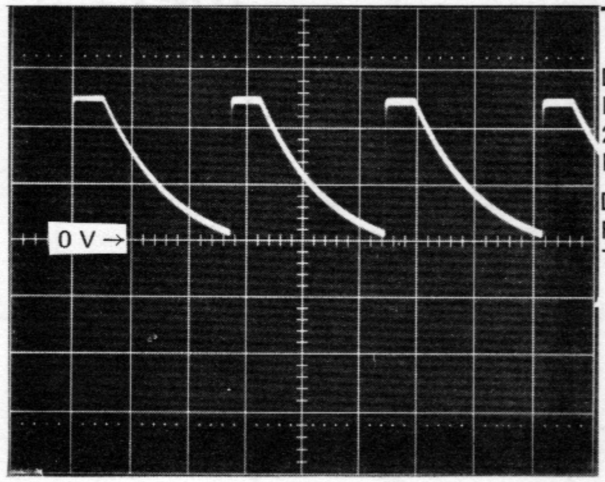
DISPLAY TIME:	mid position
FUNCTION:	CHECK
TIME BASE:	1 ms



TP11

Transfer pulse at IC 417:12. 2 μs/div, 2 V/div. PM 6650 conditions:

DISPLAY TIME:	min.
FUNCTION:	CHECK
TIME BASE:	1 ms



TP12

Display Time signal at collector of TS 401. 20 ms/div, 2 V/div. PM 6650 conditions:

DISPLAY TIME:	min.
FUNCTION:	CHECK
TIME BASE:	10 ms

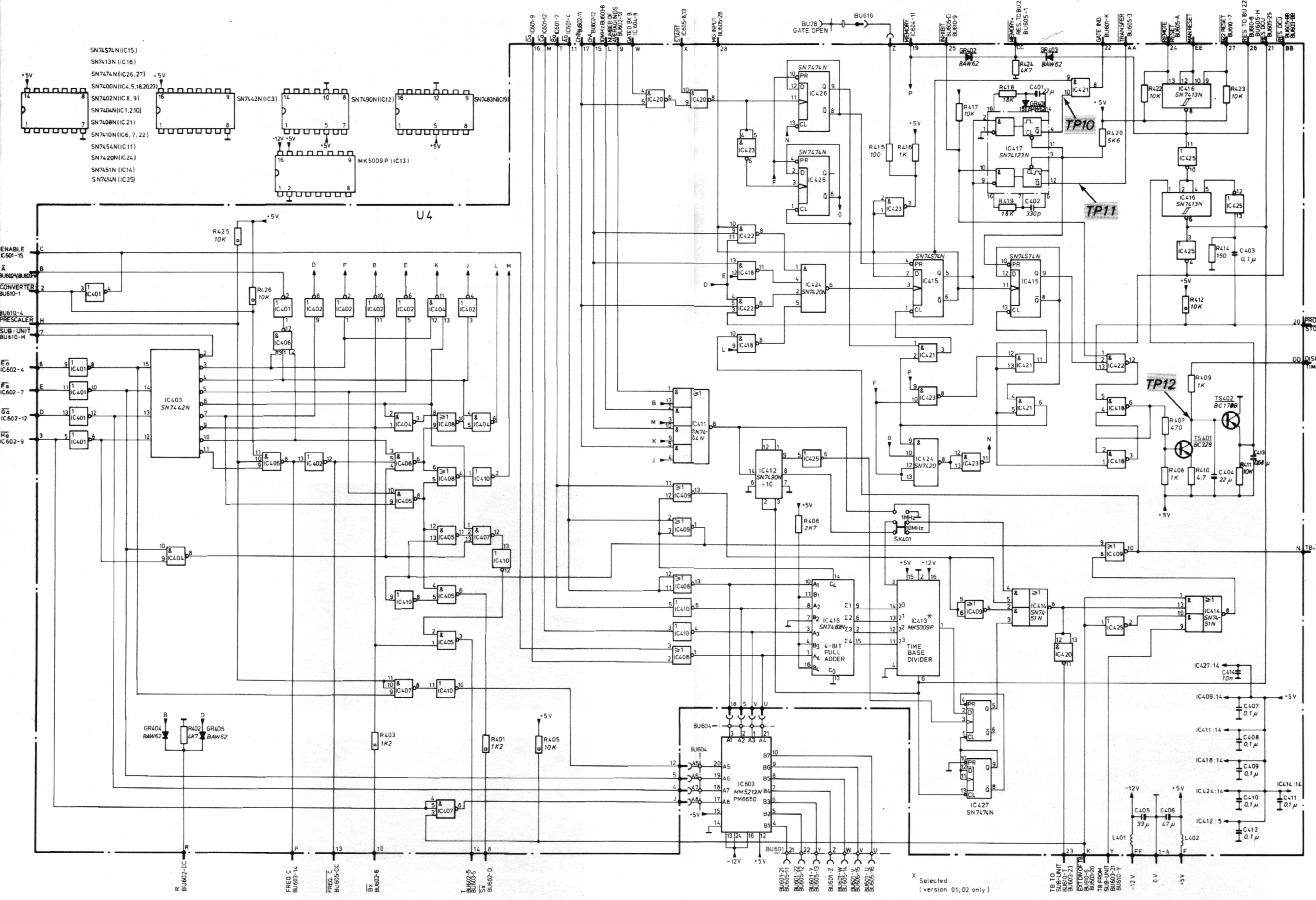


Fig. XIV-8. U4, Time Base Divider and Control Logic.
Part of U6, ROM for measurement units and decimal points

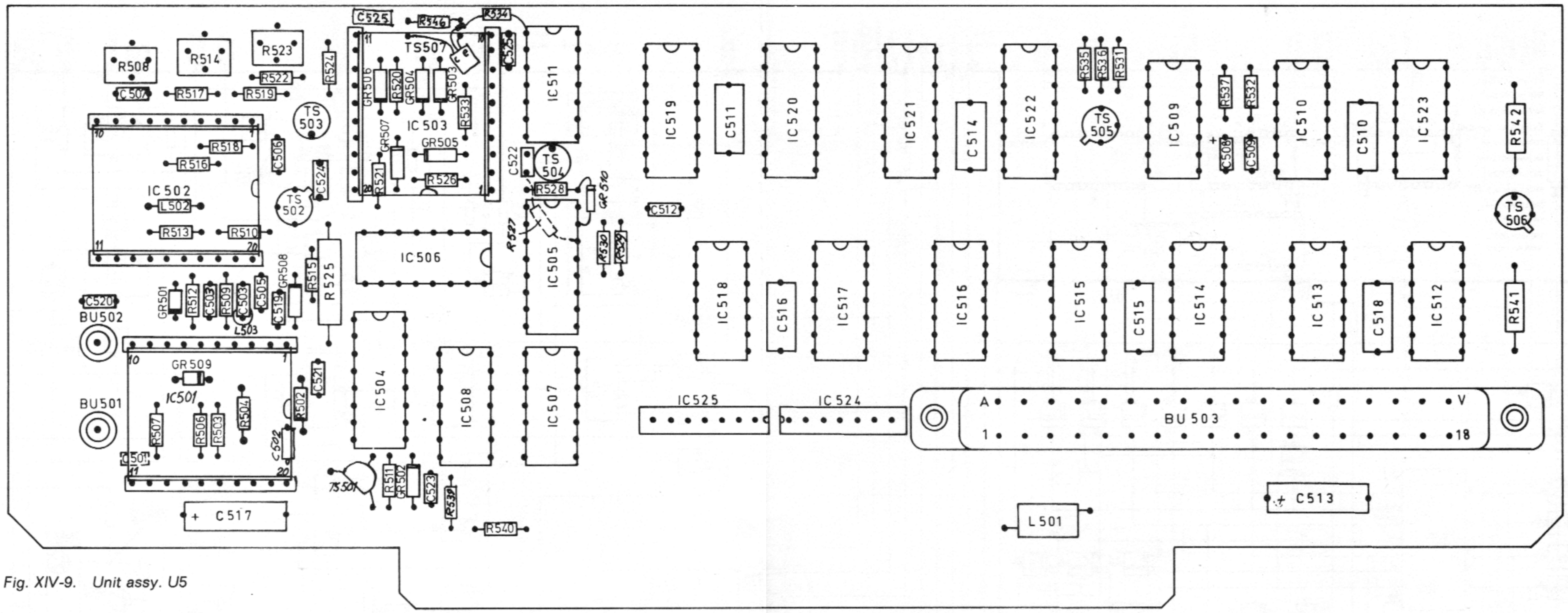
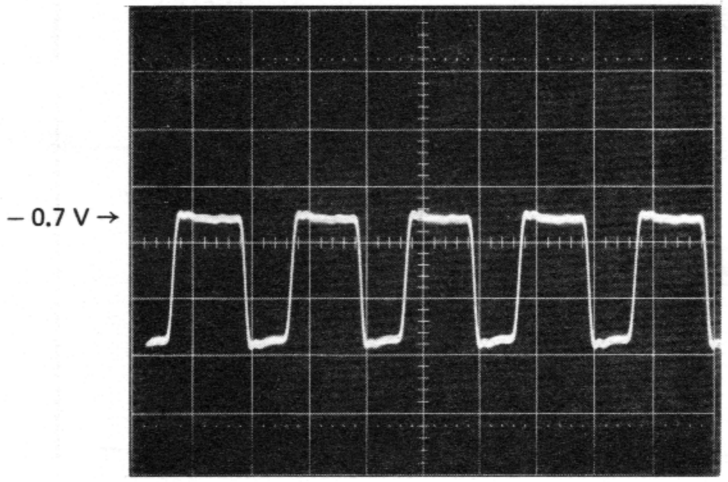


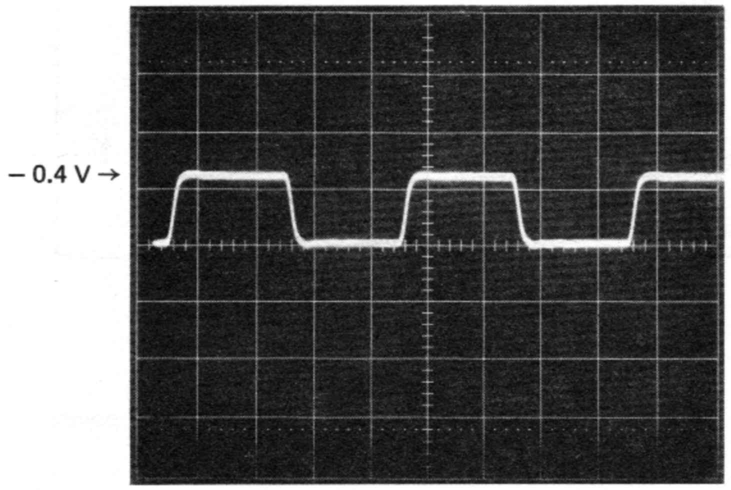
Fig. XIV-9. Unit assy. U5



TP13

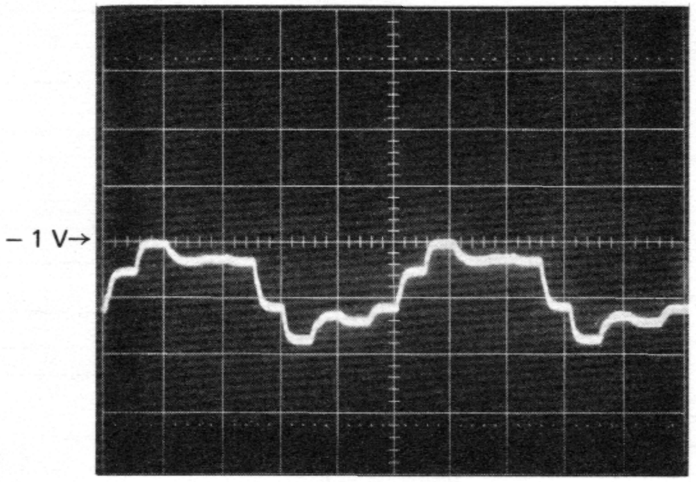
Main gate output signal at IC 501:3. 0.05 μs/div, 0.5 V/div.
PM 6650 conditions:
10 MHz OUT (rear) applied to input C

FUNCTION: FREQ C
TIME BASE: 10 s



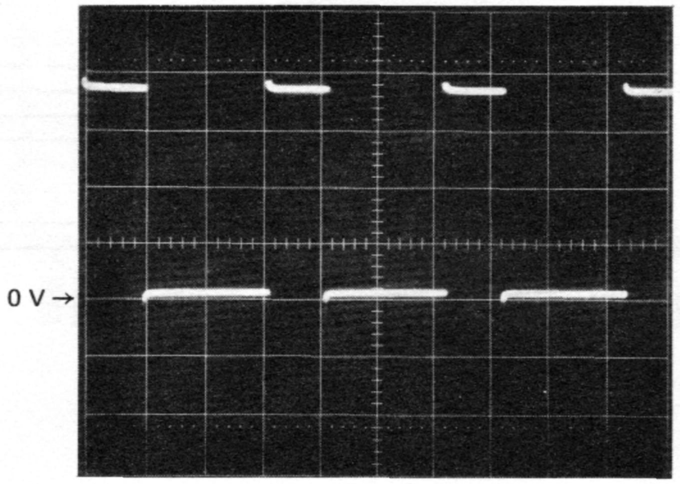
TP14

Output of binary divider IC 502:3. 0.05 μs/div, 0.5 V/div.
PM 6650 conditions as for TP13.



TP15

Output of quinary divider IC 503:3. 0.2 μs/div, 0.5 V/div.
PM 6650 conditions as for TP13.



TP16

Display clock signal at IC 509:8. 0.1 ms/div, 1 V/div.
PM 6650 conditions as for TP13.

Fig. XIV-10. U5, Main Gate, HF Decade and Decimal counting Unit

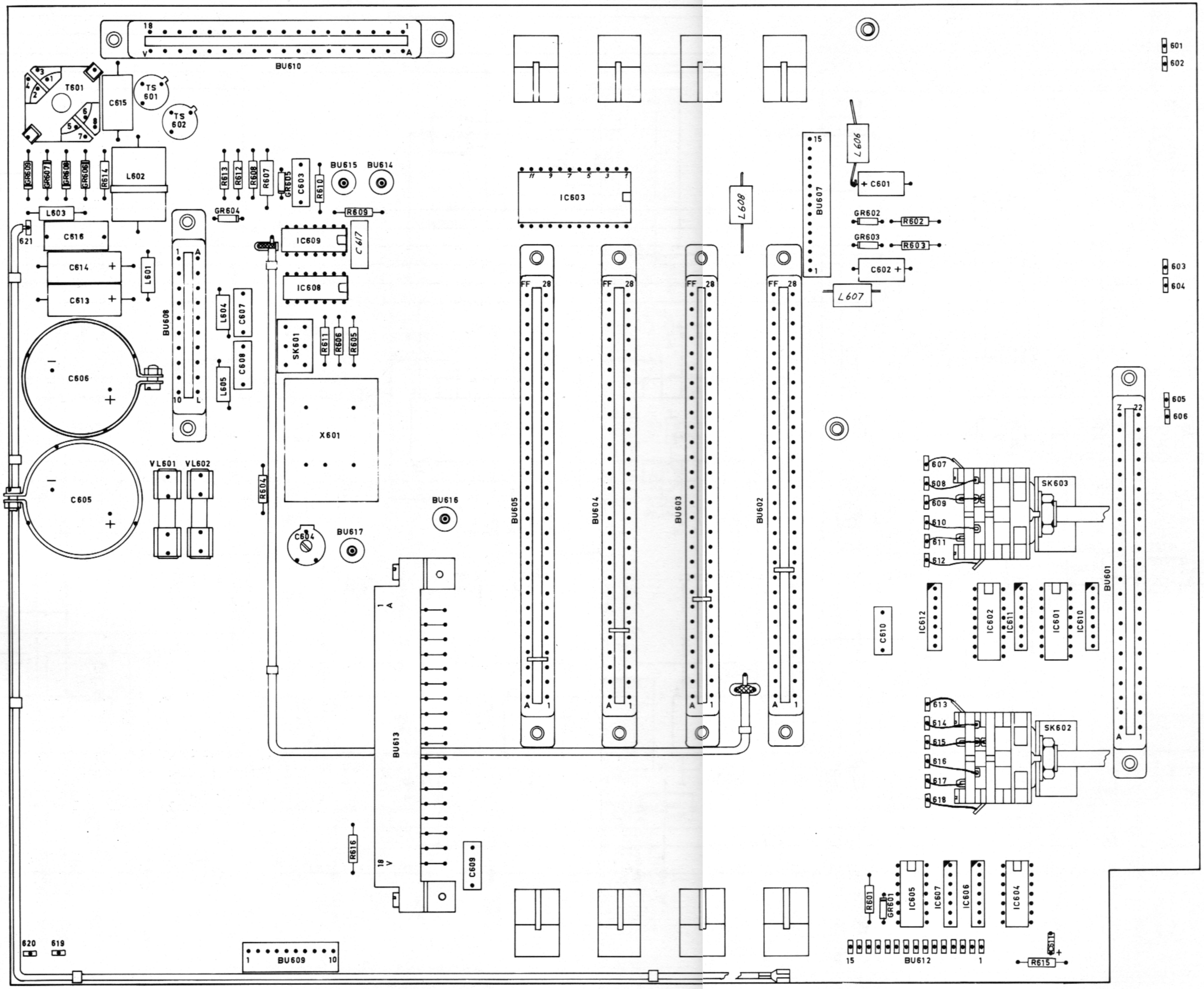


Fig. XIV-11. Unit assy. U6

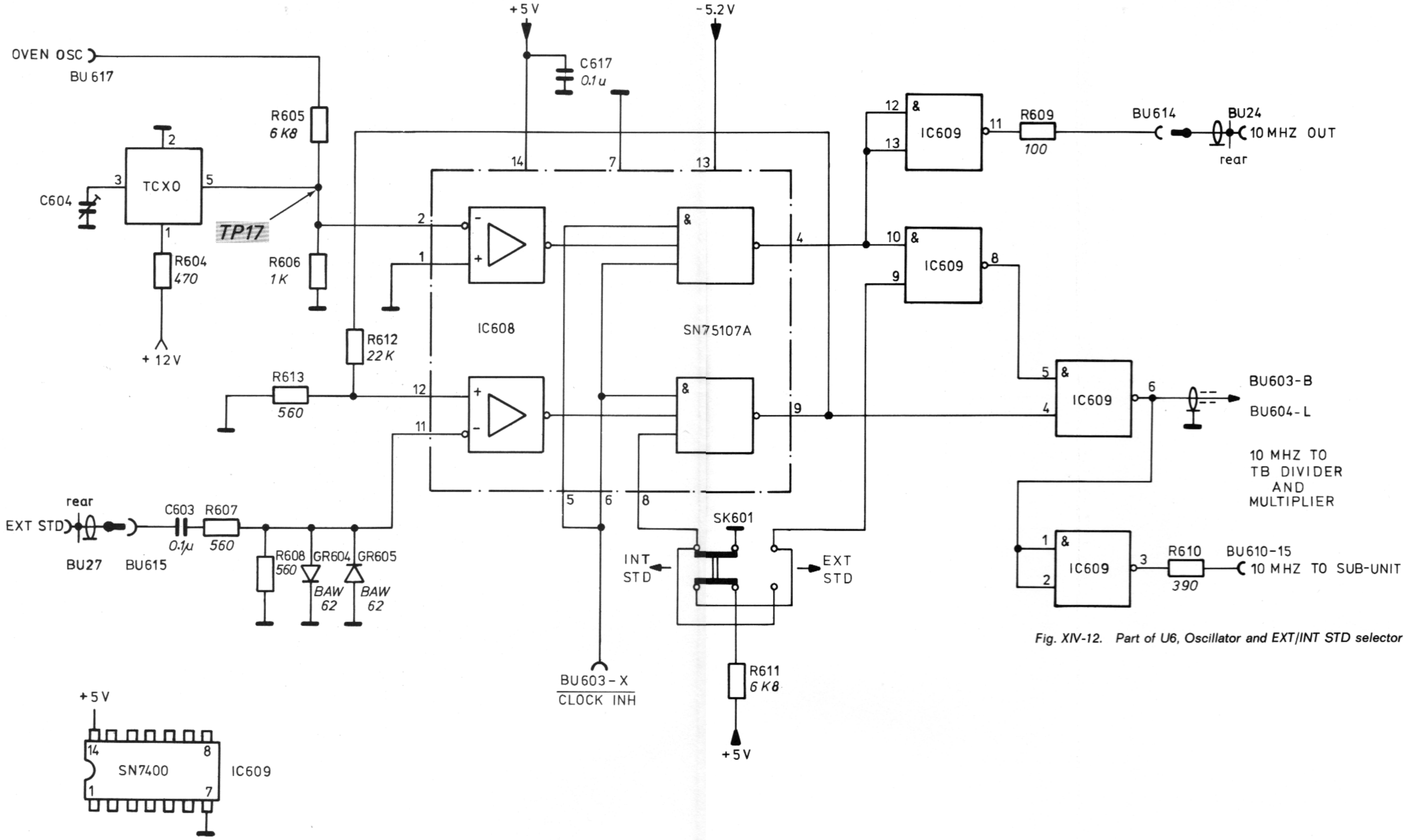


Fig. XIV-12. Part of U6, Oscillator and EXT/INT STD selector

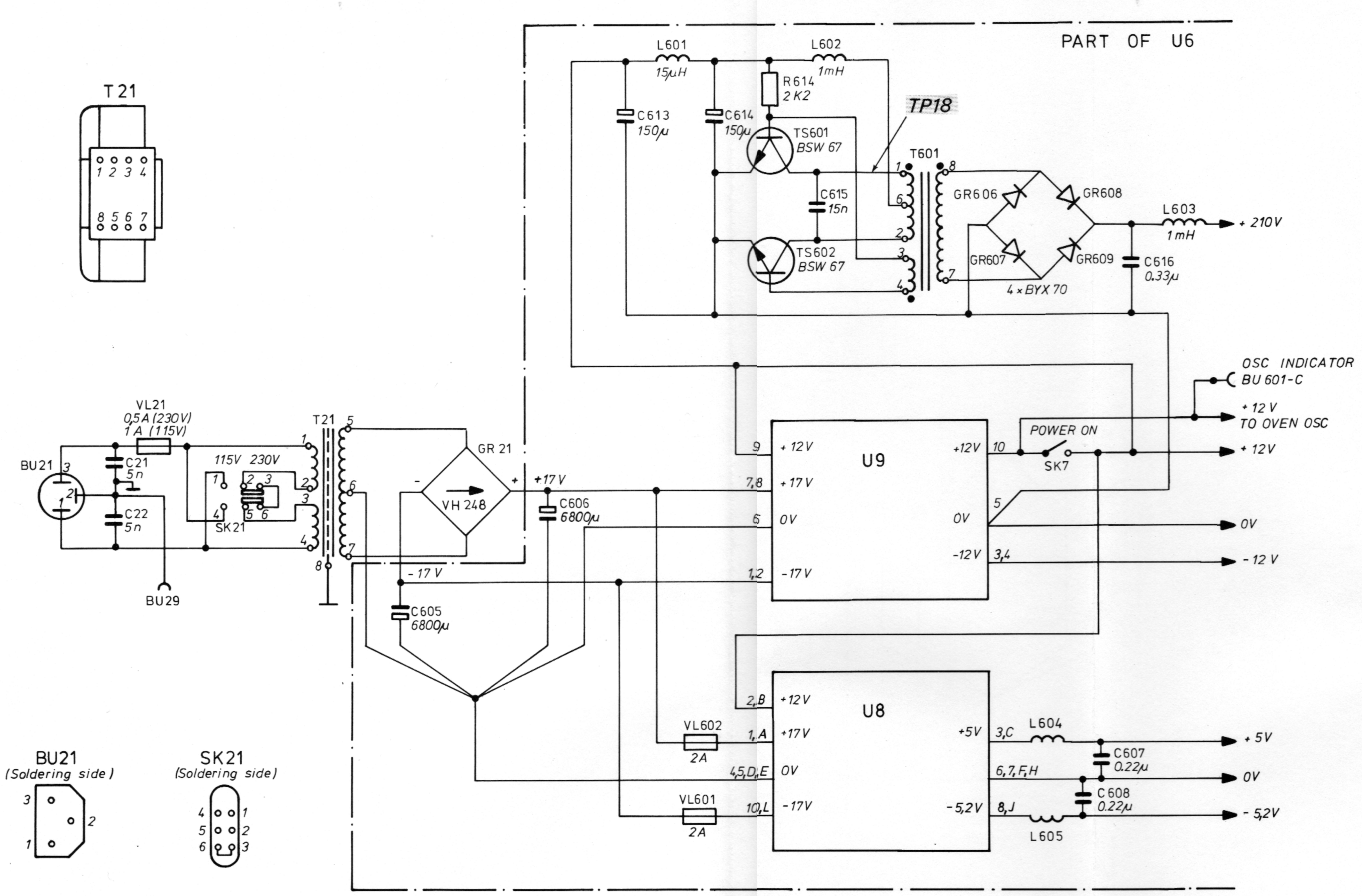


Fig. XIV-13. Part of U6, Power, Supply

PART OF U6

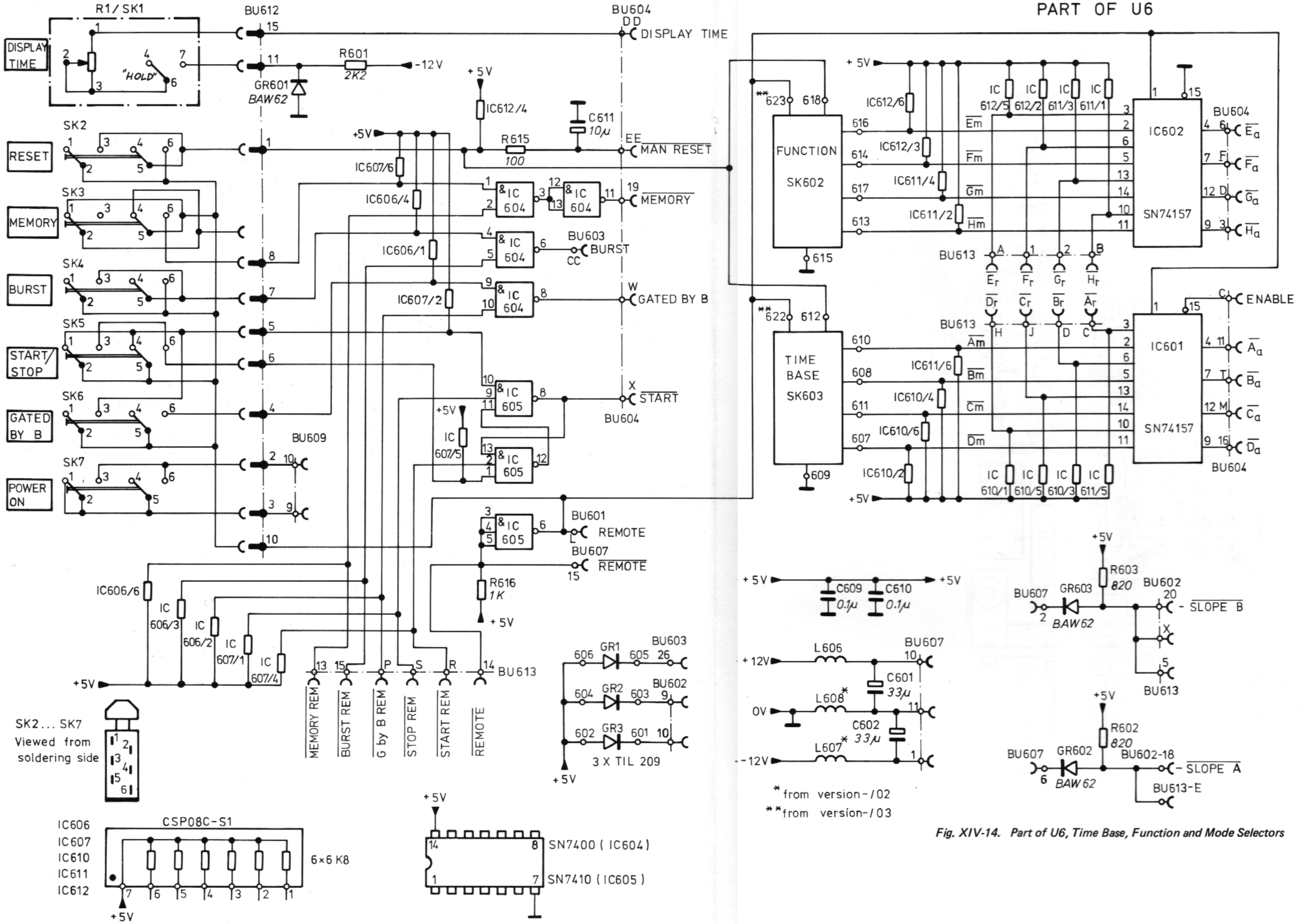


Fig. XIV-14. Part of U6, Time Base, Function and Mode Selectors

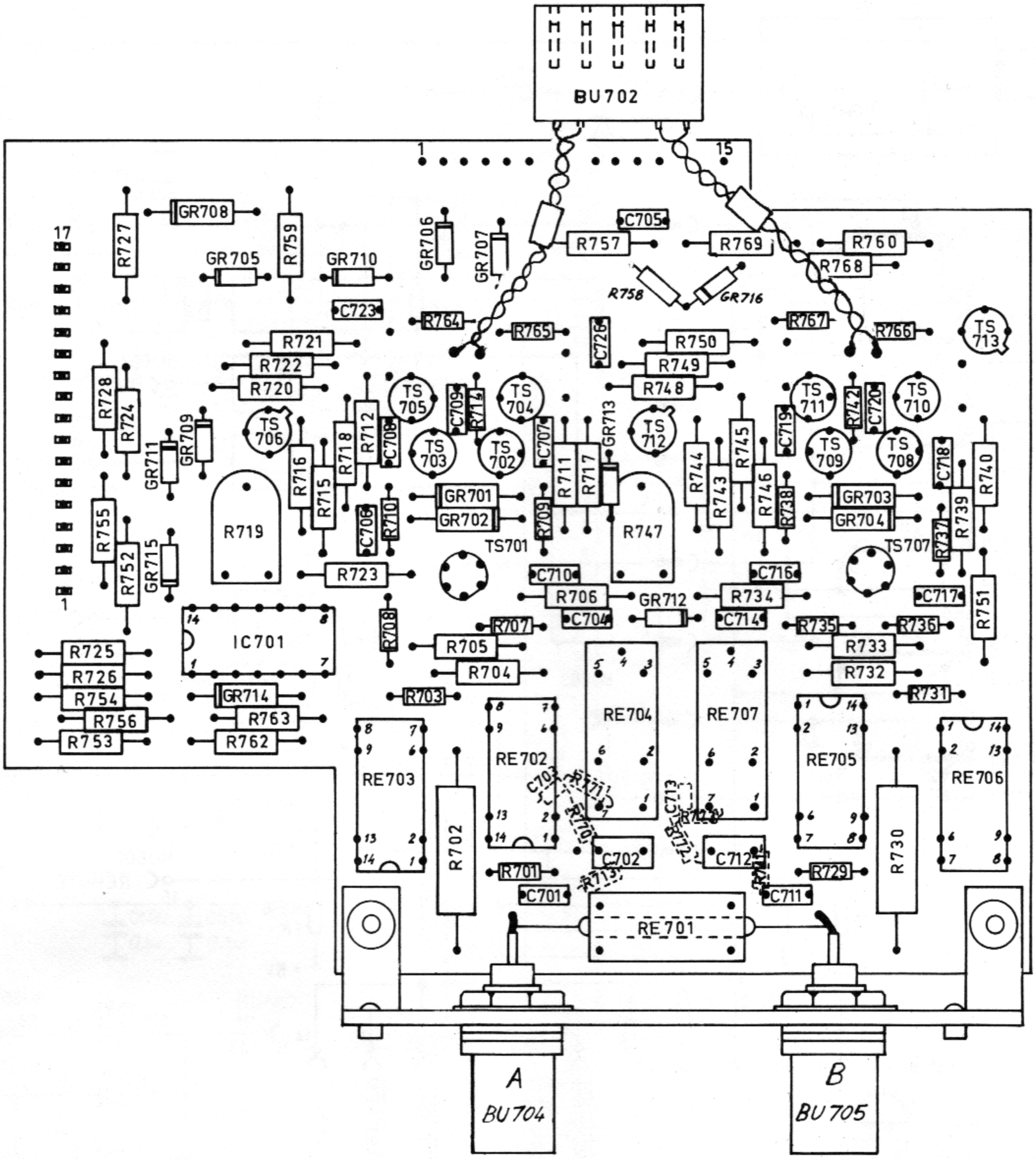


Fig. XIV-15. Unit assy. U7

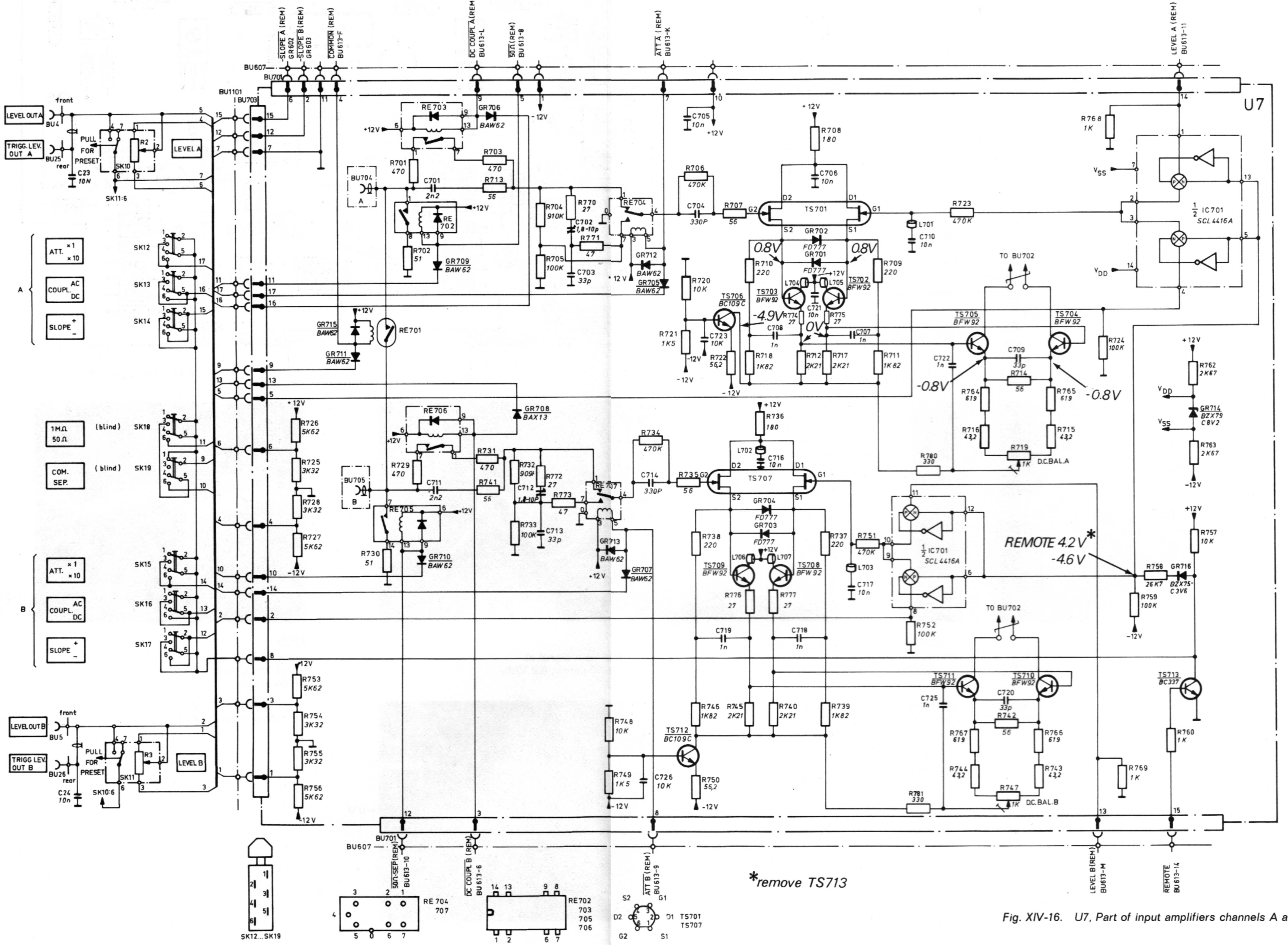


Fig. XIV-16. U7, Part of input amplifiers channels A and B

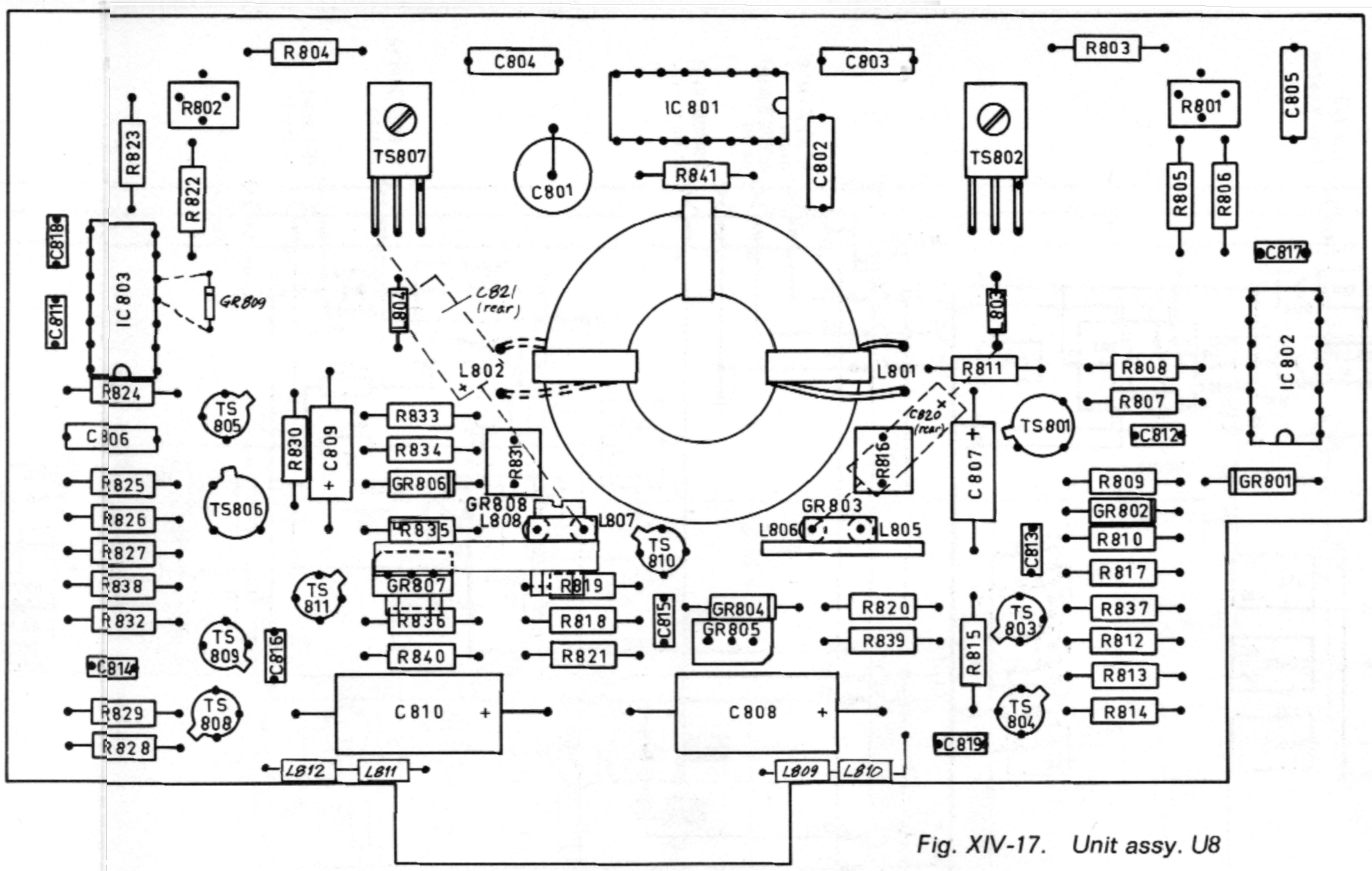
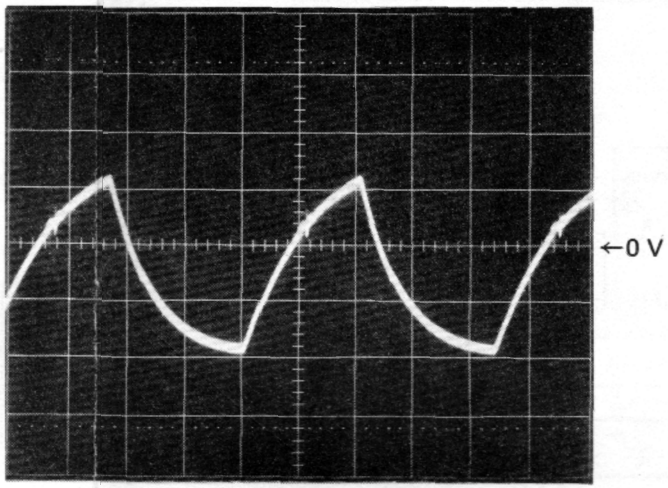
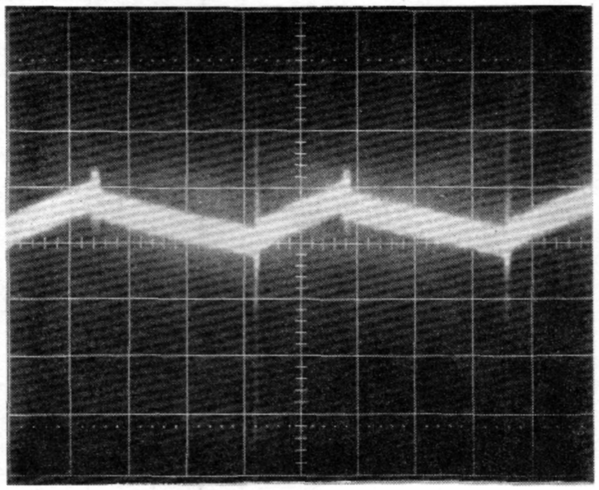


Fig. XIV-17. Unit assy. U8

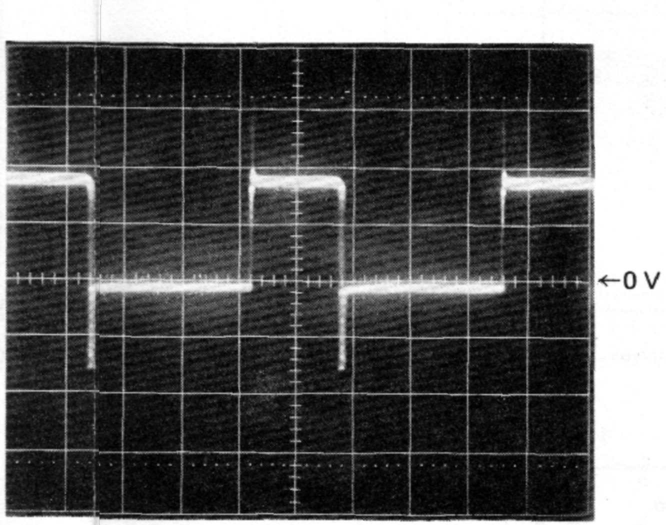


TP19
Regulator input signal at
IC 803:5. 10 µs/div, 0.2 V/div.



TP21
Ripple voltage at + 5 V
output line (R 820). 10 µs/
div, 50 mV/div.

Note: ground probe at common grounding point.



TP20
Regulated voltage at emitter
TS 802. 10 µs/div, 10 V/div.

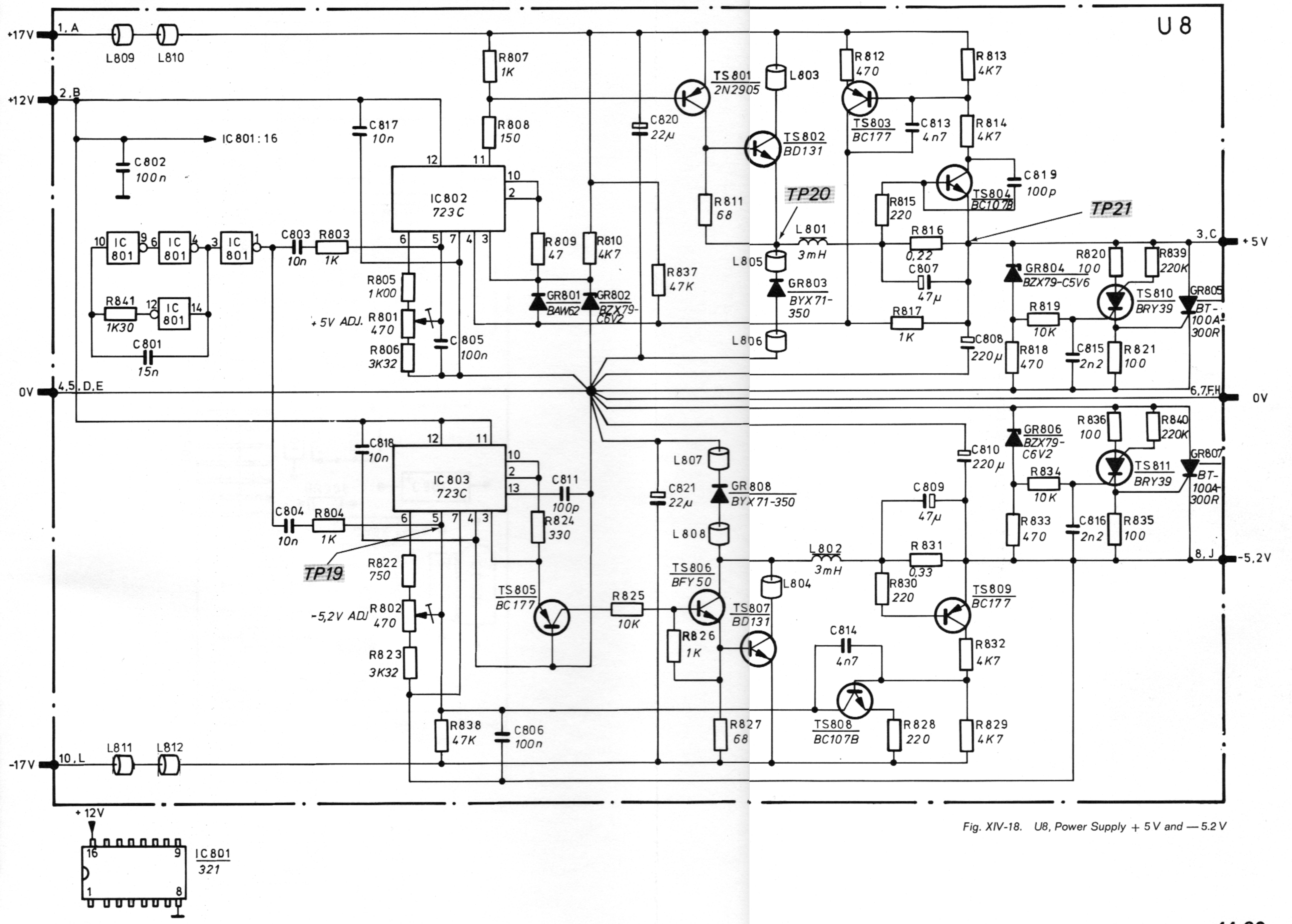


Fig. XIV-18. U8, Power Supply + 5 V and — 5.2 V

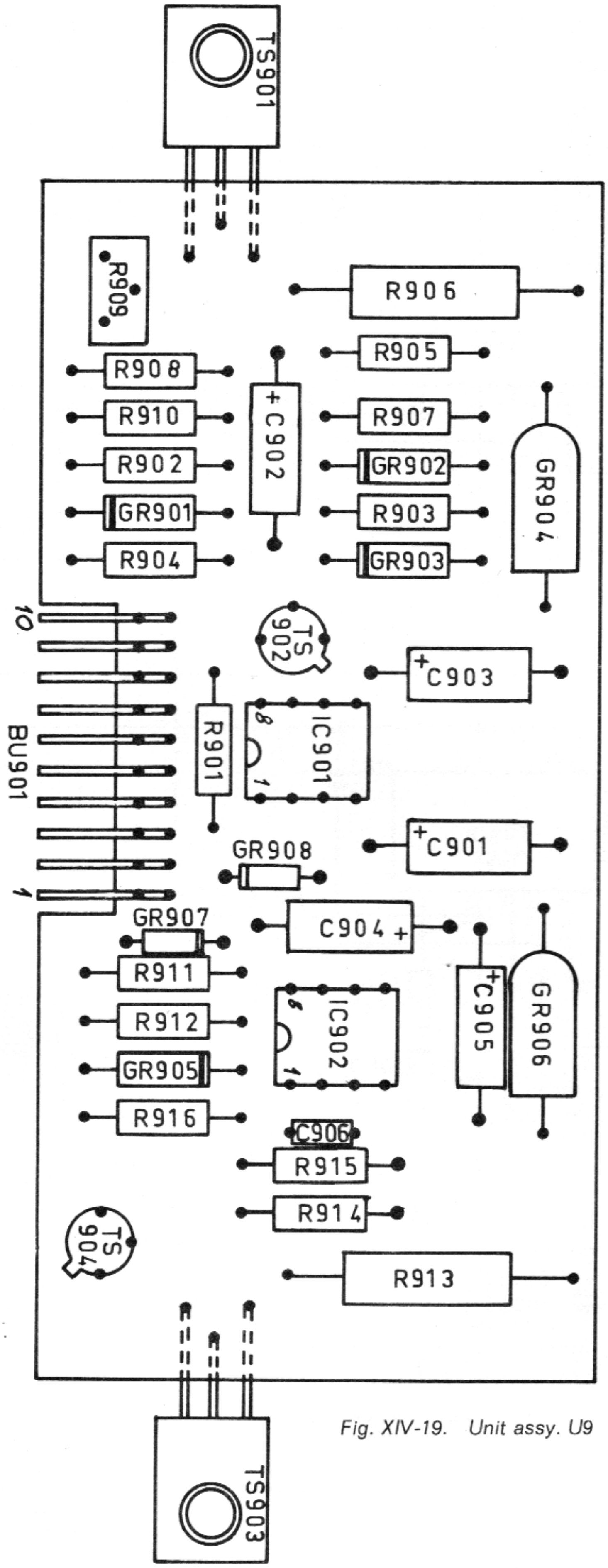


Fig. XIV-19. Unit assy. U9

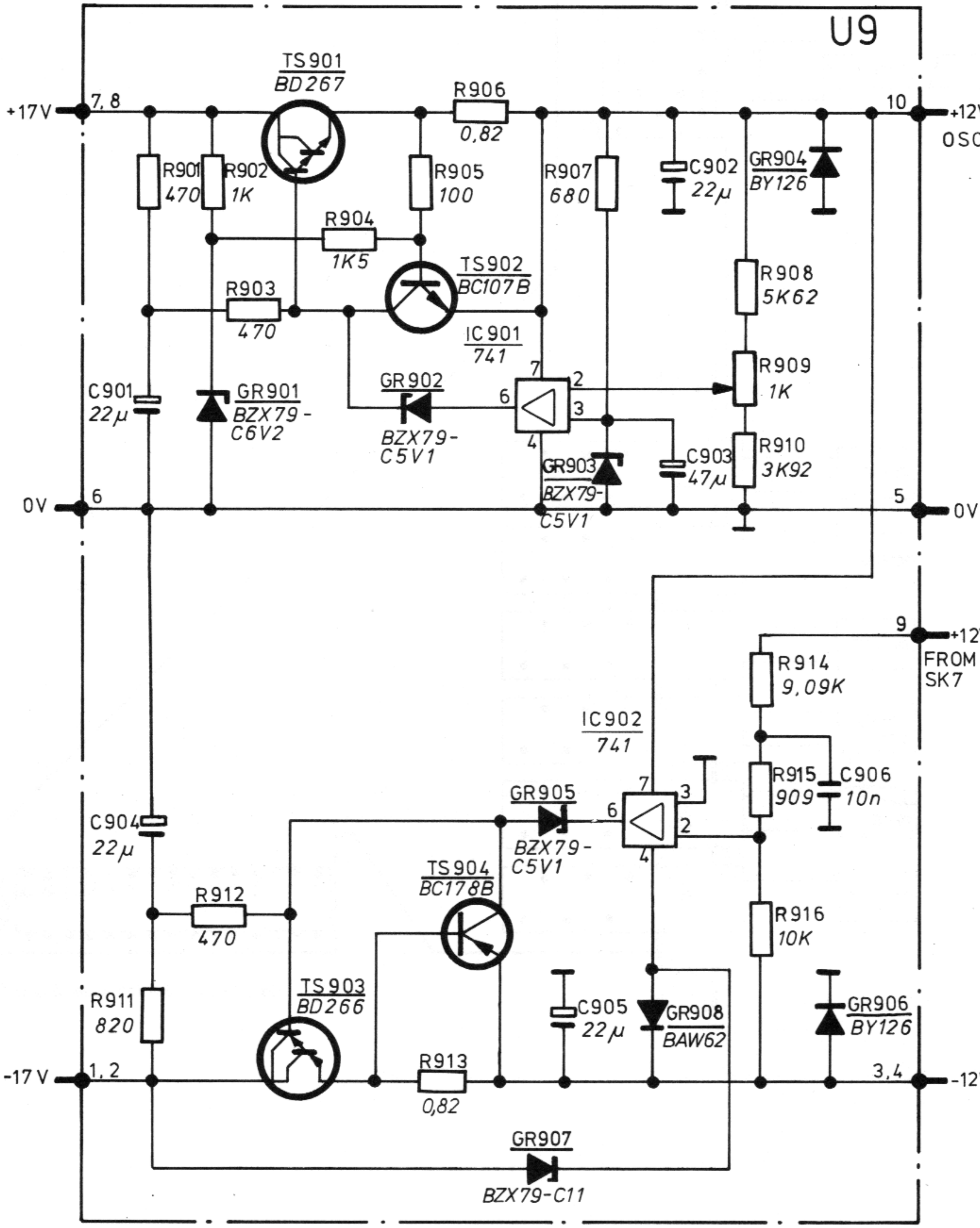


Fig. XIV-20. U9, Power Supply + 12 V and — 12 V

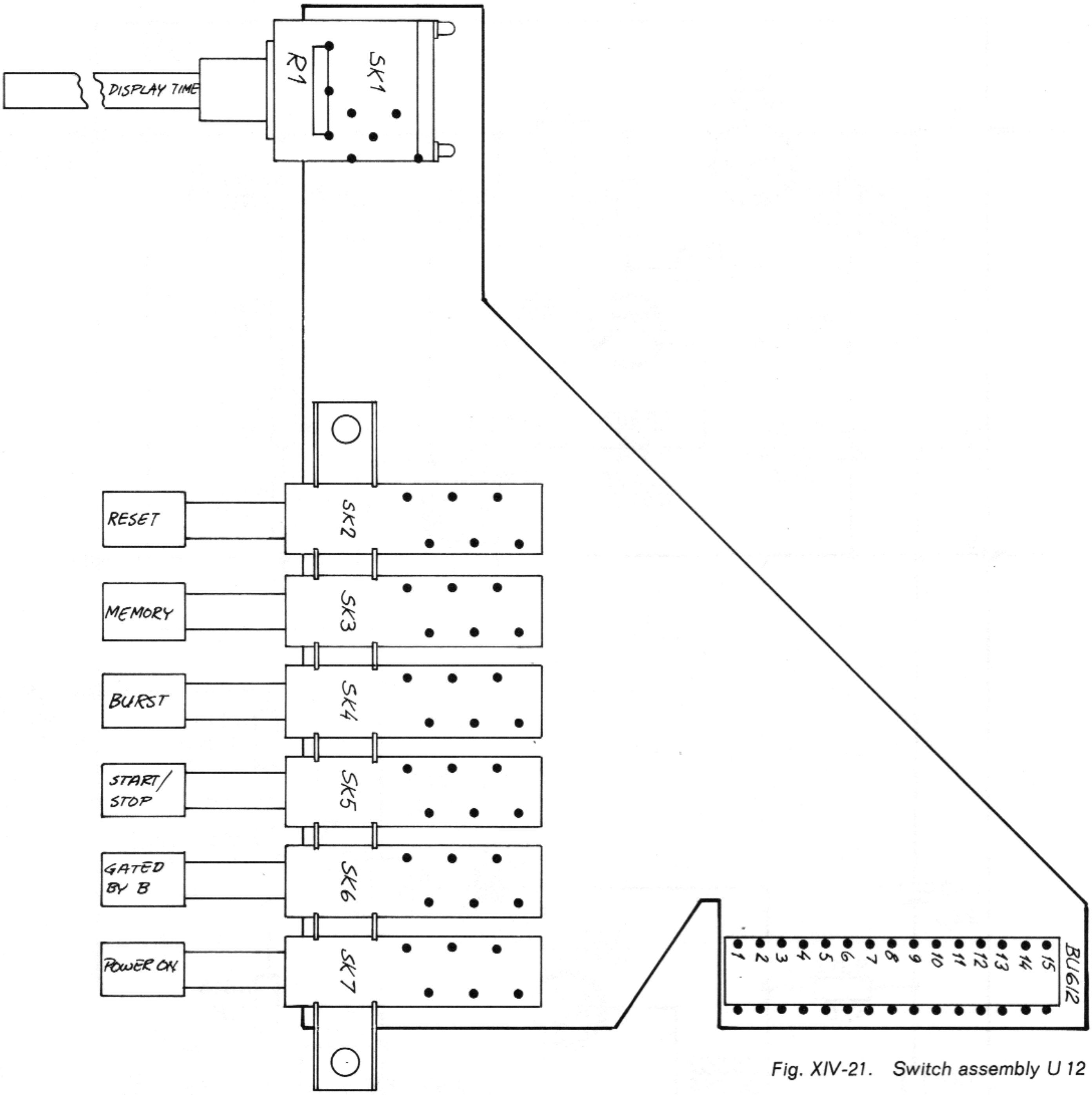


Fig. XIV-21. Switch assembly U 12

QUALITY REPORTING

CODING SYSTEM FOR FAILURE DESCRIPTION

The following information is meant for Philips service workshops only and serves as a guide for exact reporting of service repairs and maintenance routines on the workshop charts.
For full details reference is made to Information G1 (Introduction) and Information Cd 689 (Specific information for Test and Measuring Instruments).

LOCATION

☐☐☐☐

Unit number
e.g. 000A or 0001 (for unit A or 1; **not 00UA or 00U1)**

or: Type number of an accessory (only if delivered with the equipment)
e.g. 9051 or 9532 (for PM 9051 or PM 9532)

or: Unknown/Not applicable
0000

CATEGORY

☐

0 Unknown, not applicable (fault not present, intermittent or disappeared)
1 Software error
2 Readjustment
3 Electrical repair (wiring, solder joint, etc.)
4 Mechanical repair (polishing, filing, remachining, etc.)
5 Replacement
6 Cleaning and/or lubrication
7 Operator error
8 Missing items (on pre-sale test)
9 Environmental requirements are not met

COMPONENT/SEQUENCE NUMBER

☐☐☐☐☐☐

Enter the identification **as used in the circuit diagram,** e.g.:

GR1003	Diode GR1003
TS0023	Transistor TS23
IC0101	Integrated circuit IC101
RO....	Resistor, potentiometer
CO....	Capacitor, variable capacitor
BO....	Tube, valve
LA....	Lamp
VL....	Fuse
SK....	Switch
BU....	Connector, socket, terminal
TO....	Transformer
LO....	Coil
XO....	Crystal
CB....	Circuit block
RE....	Relay
BA....	Battery
TR....	Chopper

Parts not identified in the circuit diagram:

990000	Unknown/Not applicable
990001	Cabinet or rack (text plate, emblem, grip, rail, graticule, etc.)
990002	Knob (incl. dial knob, cap, etc.)
990003	Probe (only if attached to instrument)
990004	Leads and associated plugs
990005	Holder (valve, transistor, fuse, board, etc.)
990006	Complete unit (p.w. board, h.t. unit, etc.)
990007	Accessory (only those without type number)
990008	Documentation (manual, supplement, etc.)
990009	Foreign object
990099	Miscellaneous

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